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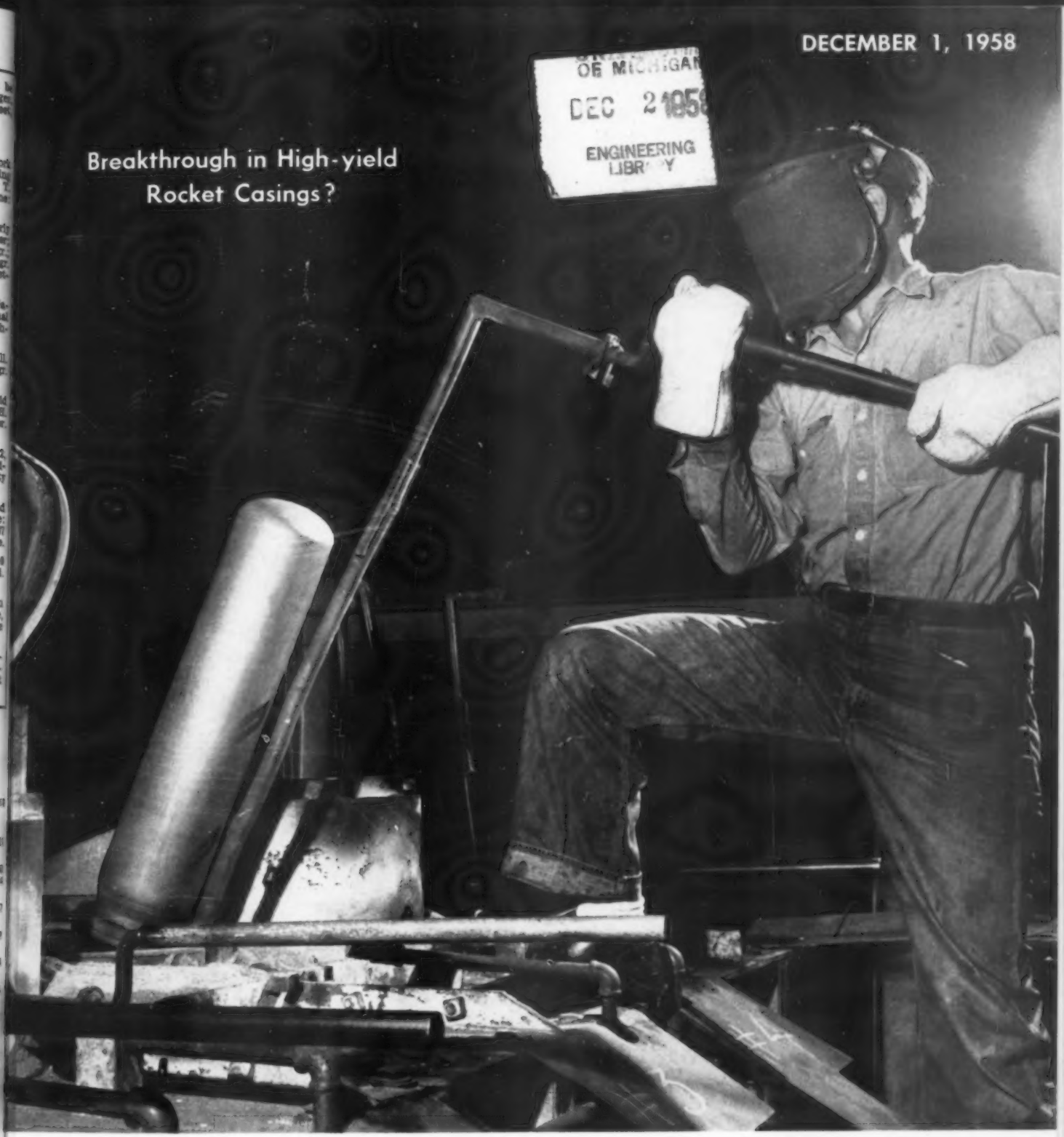

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

Engineering and Electronics Edition

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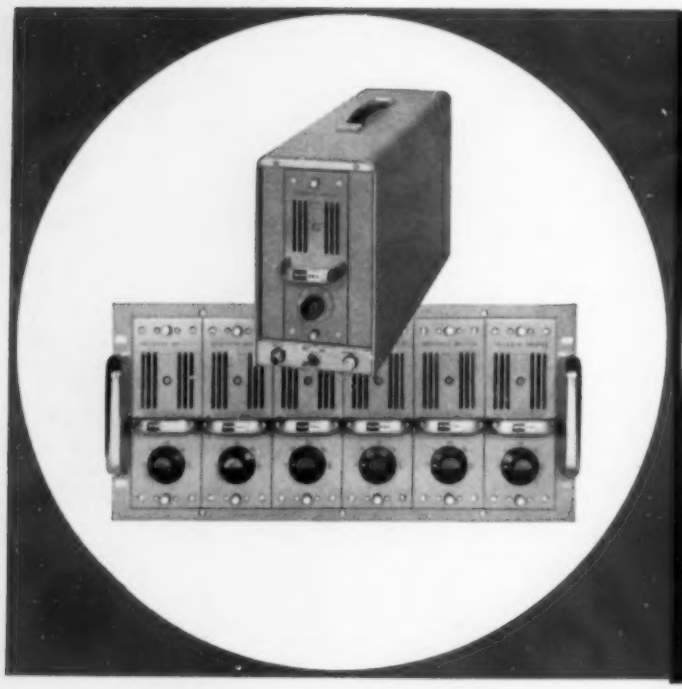

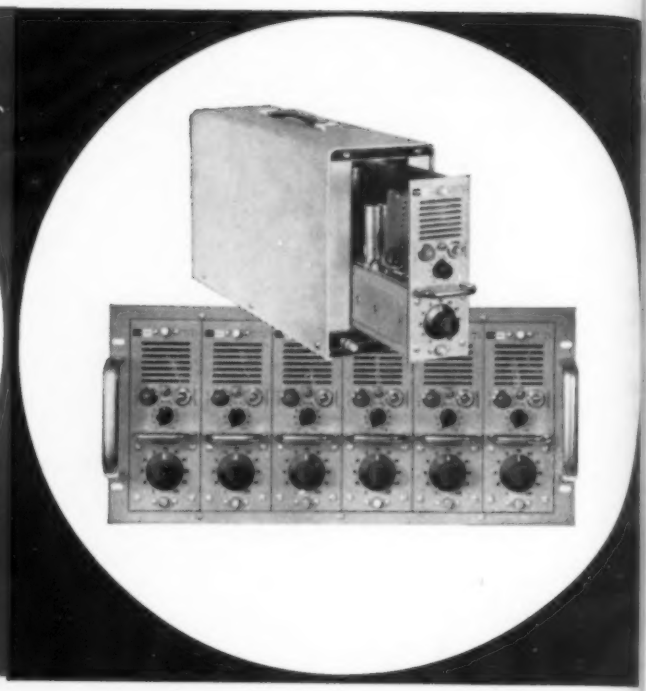

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COVER: *A Falcon motor case undergoes an oil "bath" at the Scaife Co. of Oakmont, Penn., prior to heat treatment. This is another example of how industry is finding new and better methods of forming and fabricating rocket metals. (Story on p. 25.)*

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Newest

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the missile week

washington countdown

Future looks grim . . .
for press coverage of launchings from Pacific Missile Test Range. Navy reportedly is trying to lease—for obvious security reasons—privately-owned hilltops overlooking Point Arguello site. Air Force could do the same thing for the Point Sal site, which incidentally is already seeing newsmen setting up quarters for first launch. *Sentry* satellite is expected to go between December 15-19 from Vandenberg.

***Jupiter-C* nose cone . . .**
recovered in August, 1957 and shown on television during President Eisenhower's post-*Sputnik* speech has been presented to Smithsonian Institution. Only one thing was missing —the letter from Army scientists to Maj. Gen. J. B. Medaris. Medaris had it with him in Paris where he was attending the NATO Parlimentarian meeting. However, he promised to turn it over to the Smithsonian upon his return.

A form letter . . .
to answer queries about staking claims on the moon and other planets has been prepared by the Department of the Interior. In part it says: "It is not now nor has it ever been possible for anyone to make application for or obtain the right to land on the moon or planets through the United States Government." Mail of this sort has been on a steady increase since *Sputnik I*, the Department says.

Nixon's press advisor . . .
and administrative assistant William Key, will leave that political post about December 1 and return to his old job as chief of public relations for Fairchild Engine and Airplane Corp. at Hagerstown, Md. Ex-Atlanta City Editor Key took the vice presidential spot about one year ago under considerable persuasion.

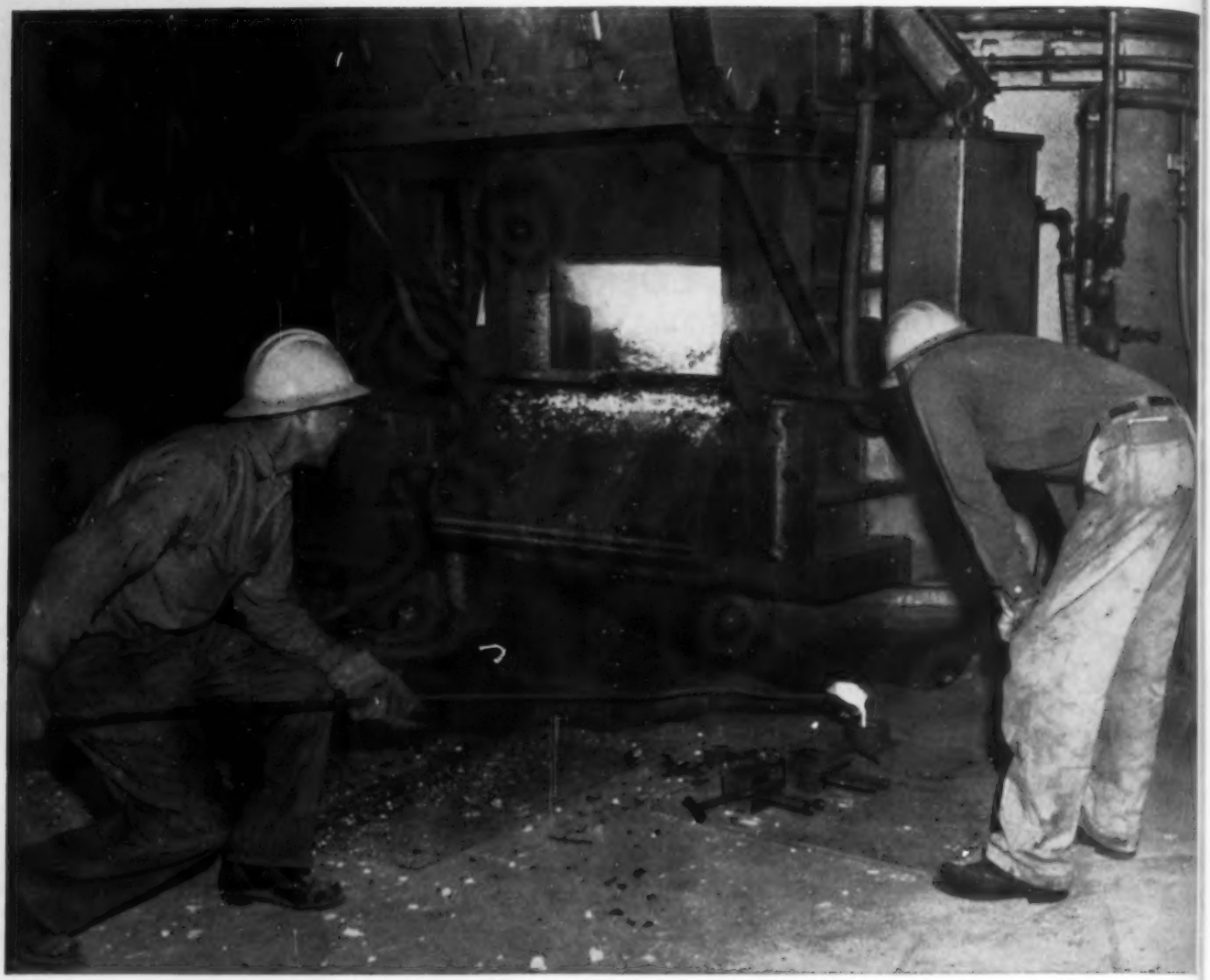
Newsmen getting educated . . .
as scientific and technical agencies in the Washington area help them to obtain a basic education in space matters. NASA recently had a briefing on basic facts of space flight. Last week, the U.S. Naval Observatory offered a special briefing on astronomy and space concepts. The Navy briefing covered space navigation, prediction of orbits, aiming space vehicles and allied subjects.

Isolated duty pay . . .
up to 40% is being considered by the Air Force for some personnel who will be manning missile bases and warning sites in remote areas. Cost is estimated at $16 million for 1960.

Armed services are unhappy . . .
with some of the personnel acquiring practices of NASA. Army Ordnance Missile Command is probably the saddest, but other agencies aren't smiling either. At Naval Research Laboratory, officials complain that the new agency took an additional 50 scientists and engineers in addition to the *Vanguard* team. Some 10 other government agencies, including the AEC, reportedly are involved. However, NASA spokesmen say that all transfers are proceeding in a planned and orderly manner.

Supreme court ruling . . .
involving income tax deductions may hold some unpleasant surprises for missile industry personnel. Court took up the case of Douglas employees who deducted meals, lodging and travel costs, claiming their transfer to another base was temporary. The court ruled that board and lodging at job sites away from established residences cannot be claimed.

Future spacemen . . .
might well ponder a report which came out of the recent convention of the Association of Military Surgeons. According to Capt. William R. Stanmeyer, USN, men living in a closed environment showed a 100% increase in tooth decay. The experiment, covering an 18-month period compared the cavity rate of men living in submarines with those based on shore. Lack of fresh vegetables and other vitamin sources, was one reason postulated.



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industry countdown

Operational Army missiles . . .

are displaying a high degree of reliability, according to Brig. Gen. J. M. Colby, Deputy Commander of the Army Ordnance Missile Command. *Nike-Hercules* tests have demonstrated a better than 80% record intercept accuracy while the *Redstone* record has a reliability score of only two failures in 41 firings since Aug. 20, 1953. Most *Nike-Hercules* failures were traced to a single subassembly which is now undergoing re-design. Out of 15 troop-fired *Corporals* launched recently in New Mexico, 14 were successful, the Army reported.

Air Force *Hare* "ramjet" . . .

missile will recombine oxygen atoms scooped up at its operating altitude of approximately 60 miles, into molecular form, releasing great amounts of energy in the process. A catalytic agent will be needed to increase the rate of recombination. Preliminary studies indicate that gold is the most promising catalyst, with aluminum and/or mica receiving attention as the reactor construction material. Additional studies are being conducted to determine more precisely the concentration of the oxygen atoms existing at the missile's proposed operating altitude. Oxygen at that altitude has been broken down into individual atoms by the action of ultraviolet radiation.

NASA is forming . . .

13 new research advisory committees to provide technical counsel and a special committee on Life Sciences to advise the agency on matters connected with human factors, medical and allied problems of the manned capsule program. The committees, which are expected to start functioning early next year, "will promote communication with other workers in the same or allied fields by reviewing research in progress, considering new problems, and making recommendations regarding the direction in which future research should go."

NASA's committee . . .

will be concerned with the following fields: fluid mechanics; aircraft aerodynamics; control, guidance and navigation; chemical energy processes; nuclear energy processes; mechanical power plant systems; electrical power plant systems; structural loads; structural design; structural dynamics; materials; and aircraft operating problems.

GAM-77 *Hound Dog* missile system . . .

will move into the production picture with the award of an $18,928,000 contract to North America Aviation's Missile Division for a limited quantity of the air-to-surface bird. Initial use of GAM-77, the missile portion of WS-131B, will be with the Boeing B-52G bomber. The missile will be powered by a PW J-52 turbojet engine with 7500-lb thrust. Directed to the target by a self-contained inertial guidance system, *Hound Dog* will carry a nuclear warhead. Meanwhile, SAC has successfully launched the McDonnell *Quail* decoy missile from both the B-47 and B-52.

NAA's ion rocket test laboratory . . .

was placed in operation last week at the Propulsion Field Laboratory of Rocketdyne. Tests will begin early in January after checkout of the lab equipment. Equipped with an electrical power supply rated at 40,000 volts at two amperes, the lab will operate engines of one-tenth pound thrust with extremely high specific impulse values. Engines will be fired in a high vacuum chamber to duplicate the airlessness of space. NAA built the lab with capital funds to advance development studies initiated in 1954.

Atlantic Research . . .

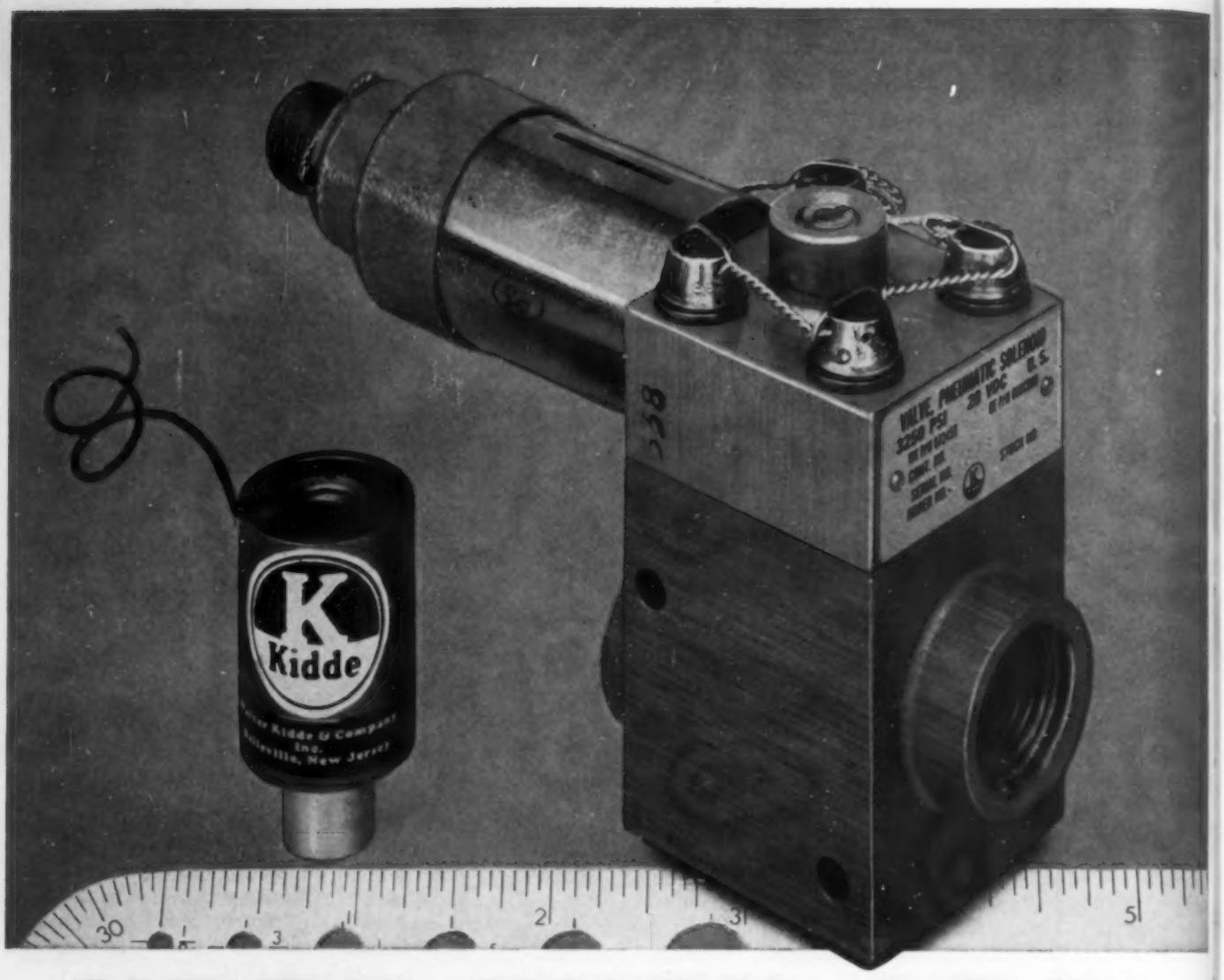
will use three of its research rockets in a *Polaris* acceleration program. The small *Arcon, Iris,* and *Arcas* are being called into service for studies, thus saving the current test vehicles. *Arcon* will investigate vibration problems expected to be encountered by the *Polaris* in flight. *Iris,* designed to carry 40 pounds of instruments to a height of 70 miles, is expected to be ready for flight testing early next year. *Arcas* will be used for missile research and routing weather data collection.

Competition has been reopened . . .

for the single chamber one million pound thrust engine, according to ARPA Director Roy W. Johnson. Development originally was contracted to Rocketdyne when program was under ARPA. NASA took over and reportedly has ordered a reopening to allow companies to bid—such as Pratt & Whitney—who were not in the rocket field when ARDC held the original competition.

No decision taken . . .

on a proposal before the Aircraft Industries Association in Phoenix recently for a name change. Topic will come up again at the Williamsburg Spring meeting.



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Proof Pressure 4875 psi
Burst Pressure 8125 psi minimum
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Flow Factor 1.37
Voltage Range 18 to 30 V.D.C.
Current (28 V. @ 80°F.) 1.2 amps.
Coil Resistance (80°F.) 21.5 to 24 ohms
Weight 1.40 lbs
Response Time 0.018 seconds

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DECEMBER 1, 1958
VOL. 4, NO. 22

missiles and rockets
MAGAZINE OF WORLD ASTRONAUTICS

Bold Orion: AF Answer to *Polaris*

by Donald E. Perry

WASHINGTON—The Air Force has a new missile system under components test in answer to the Navy's *Polaris* concept that spells new capability for Strategic Air Command bombers.

The WS-199B, of which one version is called *Bold Orion* is under test by both Lockheed Missile Systems Division and the Baltimore Division of The Martin Company, m/r has learned exclusively.

A two-stage solid propellant, it is being designed for air-to-surface launch from existing and future SAC bombers. With a maximum range of 1,000 miles, it may be the first ballistic missile that will be controllable when reentering the atmosphere, with a choice of a primary or secondary target.

• **Aloft for days**—If placed on the U.S. atomic-powered missile launching platform, now under development, it will mean the Air Force can keep the missile aloft for many days in a readiness condition for immediate retaliation. Intermediate use of the missile would be on the Boeing B-52, the Convair B-58 and the chemically-powered North American B-70, when it becomes available.

Development of the missile reportedly is being pushed by General Thomas D. White, Air Force chief of staff, and the service can be expected to officially announce that the system is under development soon after the first successful firing of its second stage, anticipated in the near future.

Gen. Thomas D. White

General White recently said that he felt that "real promise lies in the development of long-range airborne missiles which can be launched against targets from bomber aircraft." He said their use on chemical or nuclear powered bombers could "give us a capability to maintain a constant patrol of the free world skies," and this flexible force would be virtually impossible to neutralize even with a surprise attack.

Reliable sources have informed m/r that Martin has made five successful drops of a ballistic missile from a B-47 to test first stage ignition.

Bold Orion is strikingly similar to a slimmer elongated *Bullpup*, a Martin development.

It can be assumed that the missile has a length of around 20 feet and a diameter of about two feet. It is first dropped in free fall by the mother aircraft. First stage ignition propels it forward and away from the launch plane, and it then arcs into a programmed ballistic trajectory.

A third-stage Grand Central rocket used on *Vanguard* reportedly is being used as the first stage of *Bold Orion*'s test vehicle. However, Thiokol Chemical Co. reportedly will furnish the first stage in the final configuration, and the Grand Central rocket will be used as the second stage.

The missile has four movable canards on its nose for control during reentry. Four tail fins probably are fixed for stability. The finished vehicle would carry a nuclear warhead, probably of megaton yield because launch from an altitude of about 40,000 feet will reduce fuel weight, providing a larger payload. Explosive and guidance probably will separate from second stage during reentry, providing a diversion for an enemy anti-missile missile.

• **Probably Doppler**—Guidance is probably some sort of Doppler system. If so, this could mean a radio command link from launch to first stage cutoff, and possibly another link during second stage burning to provide necessary corrections for optimum cutoff point.

It conceivably would be command-guided from a control center—possibly in the bomb bay of the launch aircraft, until near the target at which time active or infra-red radar would take over. Guidance could also perform preprogrammed evasive action, changing from a primary to a secondary target to evade anti-missile defense. Guidance undoubtedly is an outgrowth of some of the Bell Labs work on radio-inertial systems for the *Thor* and *Titan*, or the GE work on the *Atlas* radio-inertial system.

The missile undoubtedly is the successor which Air Force has mentioned for the turbo-jet powered *Hound Dog*. *Hound Dog* with its 250/500-mile maximum range and altitude maximum of over 50,000 feet is definitely limited.

With the missile's range, it has a dual capacity of either launch before penetration or of going after targets too deeply within the enemy's homeland for limited range missiles.

The dollar-volume put into *Bold Orion*'s development to date has been small. But Air Force reportedly has assigned a high priority to its development and may be willing to commit large sums if it can be placed into production quickly.

ARTIST'S CONCEPTION of configuration of WS-199B, *Bold Orion* missile.

FLOURINE PROPULSION proponent John Sloop of NASA's Cleveland Research Center, confers with Fenwall's Robert Gallagher.

MAJ. GEN. H. F. TOFTOY receives James H. Wyld Memorial Award from Mrs. Wyld. Toftoy was cited for missiles development.

SPACE CAPSULES may be the conversation topic between AVCO's Arthur Kantrowitz and AF Brig. Gen. Don Flickinger.

ARS PAST President George Sutton . . . from a $5,000 deficit at beginning of his term, he ended the year with $50,000 profit.

Place: ARS Meeting—Subject: People

Photos by Norman L. Baker and William O. Miller

ABMA's Wernher von Braun and Captain Robert C. Truax of ARPA. At left is Dr. C. Generales, friend of von Braun.

THIOKOL AWARD was presented to F. H. Reardon of Princeton by James Gavin. H. R. Ferguson looks on.

GOODARD MEMORIAL award was presented by Mrs. Goodard to Robert B. Canright of NASA.

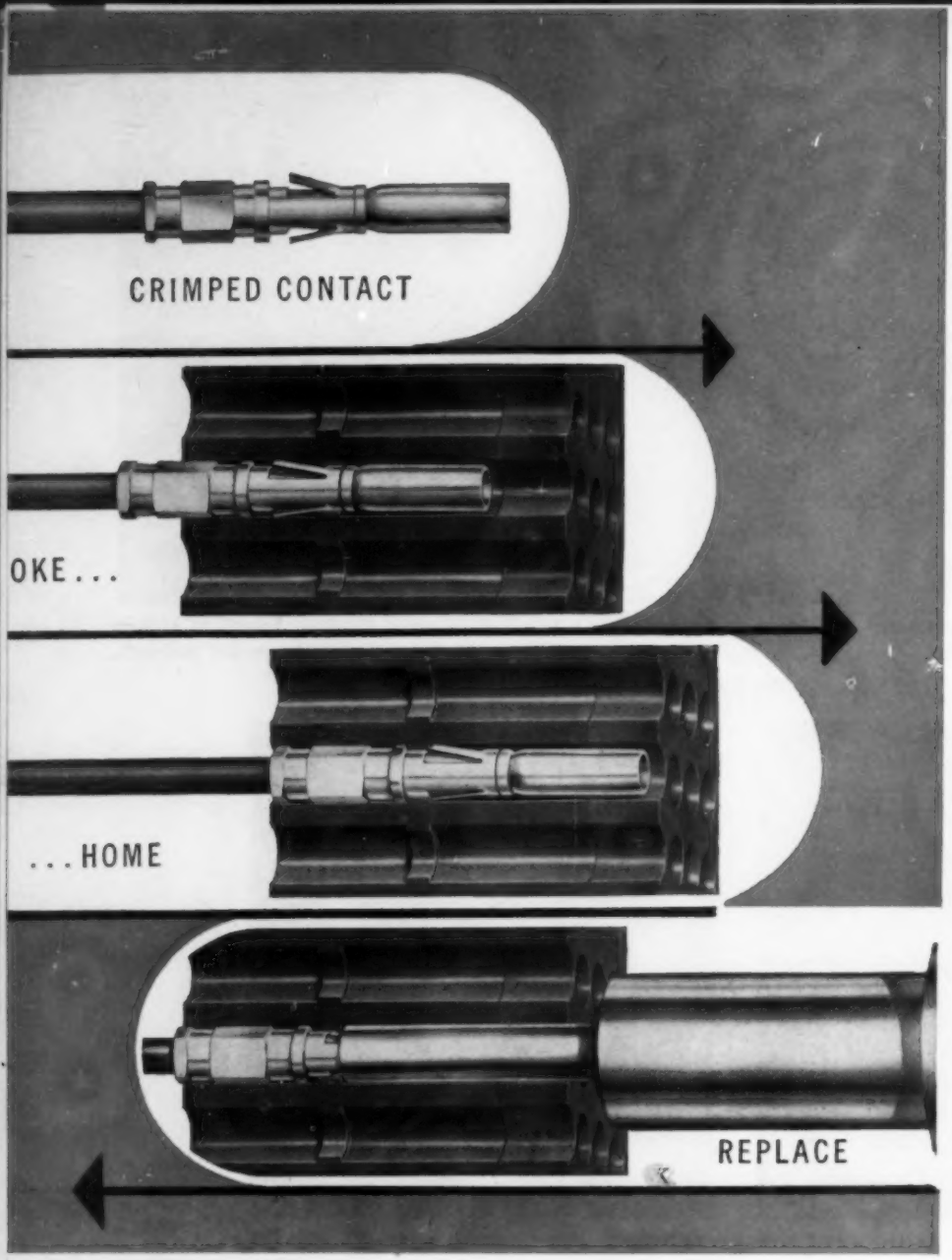
G. EDWARD PENDRAY gives Pendray Award to Homer Newell of NASA for his contribution to rocket research.

NEW ARS President John P. Stapp and m/r Editor Erik Bergaust discuss future of space flight at 13th annual meeting.

AEROJET RECEPTION was well attended. Vice-President William Gore and ARPA's Robert Truax compare notes.

ASTRONAUTICS AWARD was presented by Andrew G. Haley to Mrs. Iven Kincheloe in behalf of work of her late husband.

FINANCIER OF Goodard's work, Daniel Guggenheim and retiring ARS President George Sutton at Awards Night Banquet.



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*CONCEPT COVERED BY U.S. PATENT 2,419,018

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ARS Session Devoted to Future Developments

NEW YORK—In addition to the frankly futuristic forecasts of passenger-carrying ballistic missiles, space post offices and dealings with life on other planets, several solid facts emerged from the recent annual gathering of American Rocket Society members at the Hotel Statler in New York:

From Roy Johnson, Director of ARPA:

That for successful anti-missile defense we need to know much more about reentry physics and how a reentering body looks; how to use tools other than radar for warning and tracking; and more about the effects of nuclear weapons against nuclear weapon.

That ARPA has started a $100 million basic research program on anti-ICBM by tracking our own missiles at Cape Canaveral with $60 million in contracts already let.

That for the next several years the U.S. will depend upon *Thor*, *Jupiter*, *Atlas* and *Titan* boosters; that coupled with these ARPA has authorized the contract for development of a high liquid energy fuel upper stage (30,000 to 75,000 lbs thrust) to achieve useful satellite payloads weighing up to four and five tons.

That the order given in September for the clustered engine to develop possibly one and a half million pounds thrust is being designed to use an *Atlas* or *Titan* as second stage; is expected to be test fired in the summer with launch in 1960. Object: 25,000 pound payload on moon.

That ARPA is looking toward a cluster of four or five million-pound thrust engines for space stations within the next 6-7 years.

From Lt. Gen. James M. Gavin (Ret.):

That there are many new technological developments in the missile industry which can be used with profit in industry. For example: translating plasma technology into thermal industrial processes; a reliable flow meter, first developed for measuring liquefied gases, which has no packings or bearings; an entire new family of plastics; heat-dissipating electrical coils; more accurate measuring devices for surveyors; jet drilling devices; and multiple industry uses of infrared.

From NASA Deputy Hugh Dryden:

That the proposed transfer of Huntsville Army technicians to NASA is still under discussion; that NASA expects to use ABMA talents no matter how the decision goes; that the trend is toward sealed space cabins and away from space suits.

← Circle No. 8 on Subscriber Service Card

Papers Presented At This Year's ARS Meeting

Here are brief abstracts of technical papers presented at this year's American Rocket Society meeting in New York, November 17-21. This magazine is grateful to the American Rocket Society and the authors. Reprints of these worthwhile papers may be ordered through ARS, 500 Fifth Avenue, New York 36, N.Y.

A Rational Approach to High Performance Rocket Injector Design, I. J. Weisenberg, (674-58) Concludes that "The Kinetic approach to high performance injector design is the most desirable but is inhibited by the present state-of-the-art."

The Vaporization of Propellants in Rocket Engines, Richard J. Priem & Marcus F. Heidman, (675-58).

Vaporization Rate Limited Combustion in Bipropellant Rocket Chambers, E. Mayer, (676-58).

A Study of Combustible Mixture Formation With Liquid Fuels, Glendon Benson, M. M. El-Wakil, P. S. Myers, O. A. Uyehara, (677-58).

Psychophysiological Aspects of the Man High Experiment, Lt. Col. David G. Simons, (678-58).

Application of a New Technique for Recording Skin Resistance Changes, E. Z. Levy, G. E. Ruff, V. H. Thaler, (679-58). A summary of recent research at Aero Medical Laboratory, WADC, on measurement of skin resistance to determine fatigue.

Modifiability of Day-Night Cycling, George T. Hauty, (680-58). Deals with recycling human activity to increase efficiency as part of man-machine system.

Psychophysiological Aspects of a Multiple Crew Compartment Study, Capt. C. F. Gell (681-58). Concludes that men with good morale, discipline, training and motivation can tolerate long periods of confinement such as might be encountered in spaceflight.

Current Studies at Walter Reed, Lt. Col. Paul B. Yessler, (682-58). Deals with studies on sleep deprivation, experimentally-conditioned behavior in animals and some aspects of the neuro-endocrinological response to stress.

The Measurement of Human Adaptation to Stress, Sanford I. Cohen, A. J. Silverman, B. Shmavonian, (683-58).

The Electroencephalogram as a State-of-Consciousness Indicator Under Balloon Flight Conditions, Neil Burch, (685-58).

Combustion Research—Whence and Whither, John B. Fenn, (686-58).

Correlation and Prediction of Flame Properties, Melvin Gerstein, (687-58).

Recent Advances in Gaseous Detonation, Robert A. Gross, (688-58).

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. . . ARS abstracts

Nuclear Rocket Propulsion Program at Los Alamos, Raemer E. Scheiber, (689-58).

Some Boundary Conditions for the Use of Nuclear Energy in Rocket Propulsion, Robert W. Bussard, (690-58). Concludes that "Propellant specific impulse should be greater than 1000 sec but need not exceed 3000 sec for a useful payload capacity for most missions within the solar system."

Optimum Thrust Programming of Nuclear Rockets, Chiao J. Wang, Herbert R. Lawrence, George W. Anthony, (691-58). For a nuclear rocket of variable specific impulse, there is an optimum way of programming the thrust for a mission.

Design Considerations for Nuclear Rocket Test Stands, Sidney G. Rumbold, (692-58).

Dynamic Analysis of a Nuclear Rocket Engine System, Bernard R. Felix, (693-58).

Navy Interests in Sealed Cabins, Malcolm D. Ross, (694-58).

Sealed Cabins for Life Satellites, Lt. Col. David G. Simons & Capt. Eli L. Bleeding, (695-58).

Sealed Cabins: Advanced Research Projects Agency Views, Richard D. Holbrook, (696-58).

Sealed Cabin Requirements for Non-Military Missions, Max M. Faget & C. W. Mathews, (697-58).

Sealed Cabins: Area of Indecision, Irwin Cooper, (698-58).

Climatic and Structural Aspects of Sealed Cabins, F. L. Dickey and G. H. Knipp, (699-58). Considers advantages to the crew of an optimum internal atmosphere and pressure and the effects on a sealed cabin structure.

Accelerations of Space Flight, Col. John P. Stapp, (700-58). States that accelerations inherent in present 3-stage rocket systems are tolerable by man and could conceivably be used for manned space flight.

Sealed Cabins: Research Program, Otto Winzen.

Space Cabin Requirements as Seen by Subjects in the Space Cabin Simulator, Capt. Willard R. Hawkins, (702-58).

Psychological Aspects of Sealed Cabins, Arnold Small, (703-58).

Biothermal Aspects of Re-entry from Extra Atmosphere Flight, Earl T. Carter & M. W. Jack Bell, (704-58). Points out certain biothermal problems expected to arise during re-entry of a manned vehicle.

Air Turborocket Developments, William N. Gilmer.

External Burning Ramjets, Gordon L. Dugger, Louis Monchick & R. H.

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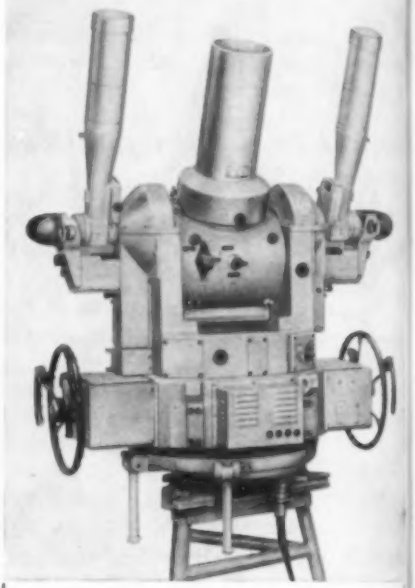

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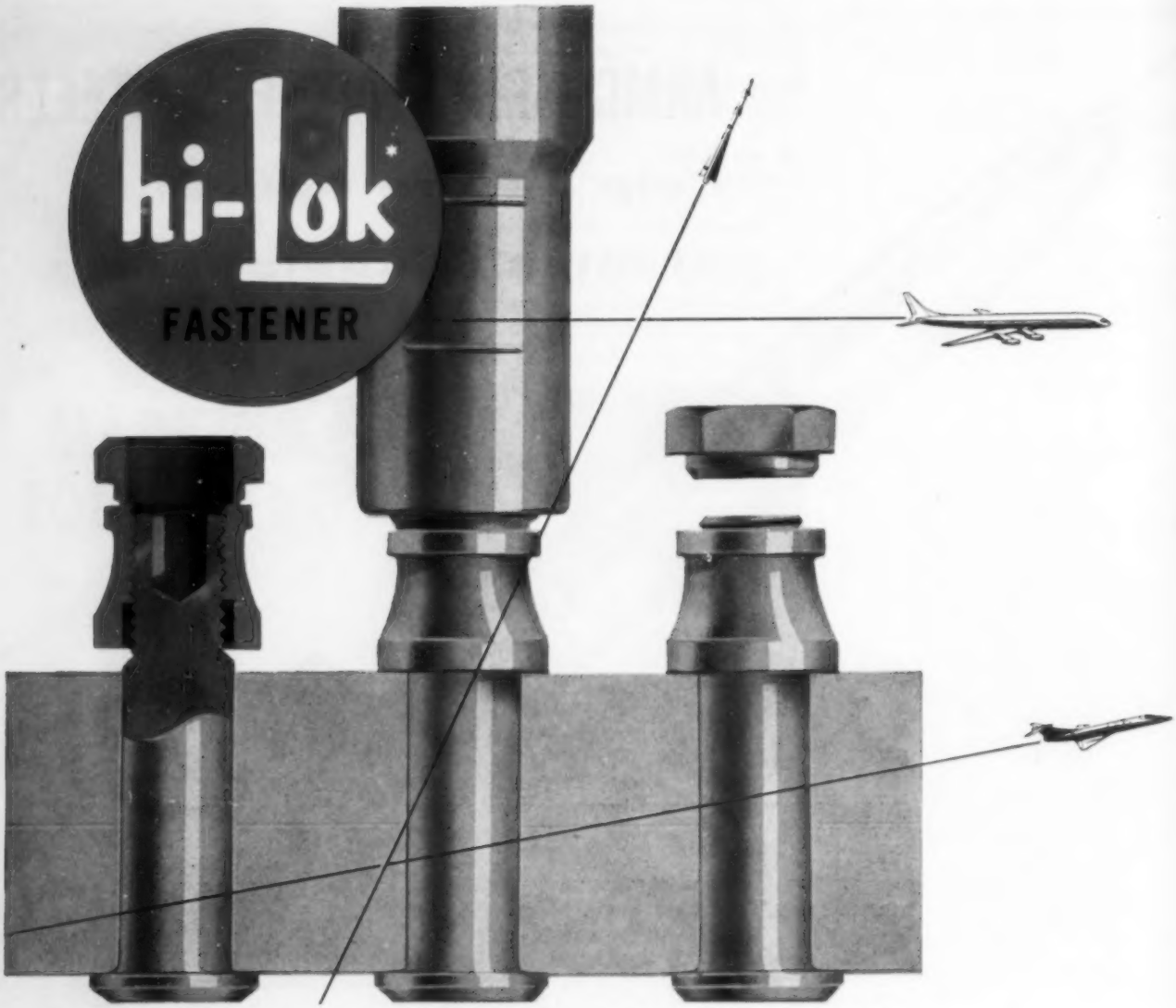

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Cramer.

Solid Fuel Ramjet Developments, H. Powell Jenkins, Jr.

General Behavior of Hydromagnetic Fluids, Russell M. Kulsrud, (705-58).

Aerothermodynamic and Electrical Properties of Some Gas Mixtures to Mach 20, W. Chinitz, L. Eisen, R. Gross, (706-58).

Experimental Magneto-Aerodynamics, Richard W. Zeimer, (707-58), Draws several conclusions, including the fact that experimental data for the stand-off distance ratio agree with theoretical predictions.

Preliminary Studies on Electrical Propulsion Systems for Space Travel, Robert Fox, (708-58). States that the problems in this field do not appear to be greater than those associated with development of modern high performance jet and rocket engines.

Magnetohydrodynamics in Aeronautics, W. R. Sears, (709-58). Notes that future applications may have to wait for new developments in other fields, such as lightweight fission or fusion power sources.

Commercial Rocket Airplane: A Connecting Link to Manned Space Flight, Robert A. Cornog, (710-58).

The Geodetic Satellite, Robert P. Haviland, (711-58). Discusses uses of satellites for increasing knowledge of the earth, its shape, gravity field, etc.

The Orbital Post Office, Sidney Metzger, (712-58).

Space Law: Recent Practical Achievements, Andrew G. Haley, (714-58).

A Preliminary Experiment with Recoverable Biological Payloads in Ballistic Rockets—Project MIA, F. L. van der Wal and W. D. Young, (715-58). Disucsses the Thor-Able program which launched mice into space.

Lockheed X-17 Test Vehicle and Its Applications, Ronald Smelt, (716-58).

Far Side Rocket Research Program, Herbert L. Karsch, (717-58). Discusses the program which developed an important technique in less than one year for less than one million dollars.

Explorer Rocket Research Program, Geoffry Robillard, (718-58).

Vanguard Research Rocket Program, Milton Rosen, (719-58).

NASA Research Rocket Program, A. O. Tischler, (720-58).

Reduction of Flight Time and Propellant Requirements of Satellites with Electric Propulsion by the Use of Stored Electrical Energy, Morton Camac, (721-58).

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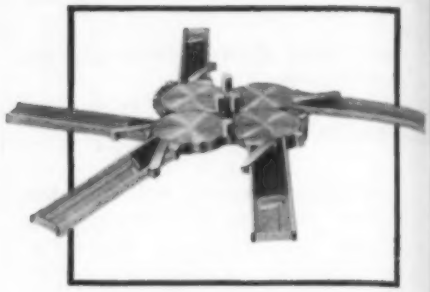

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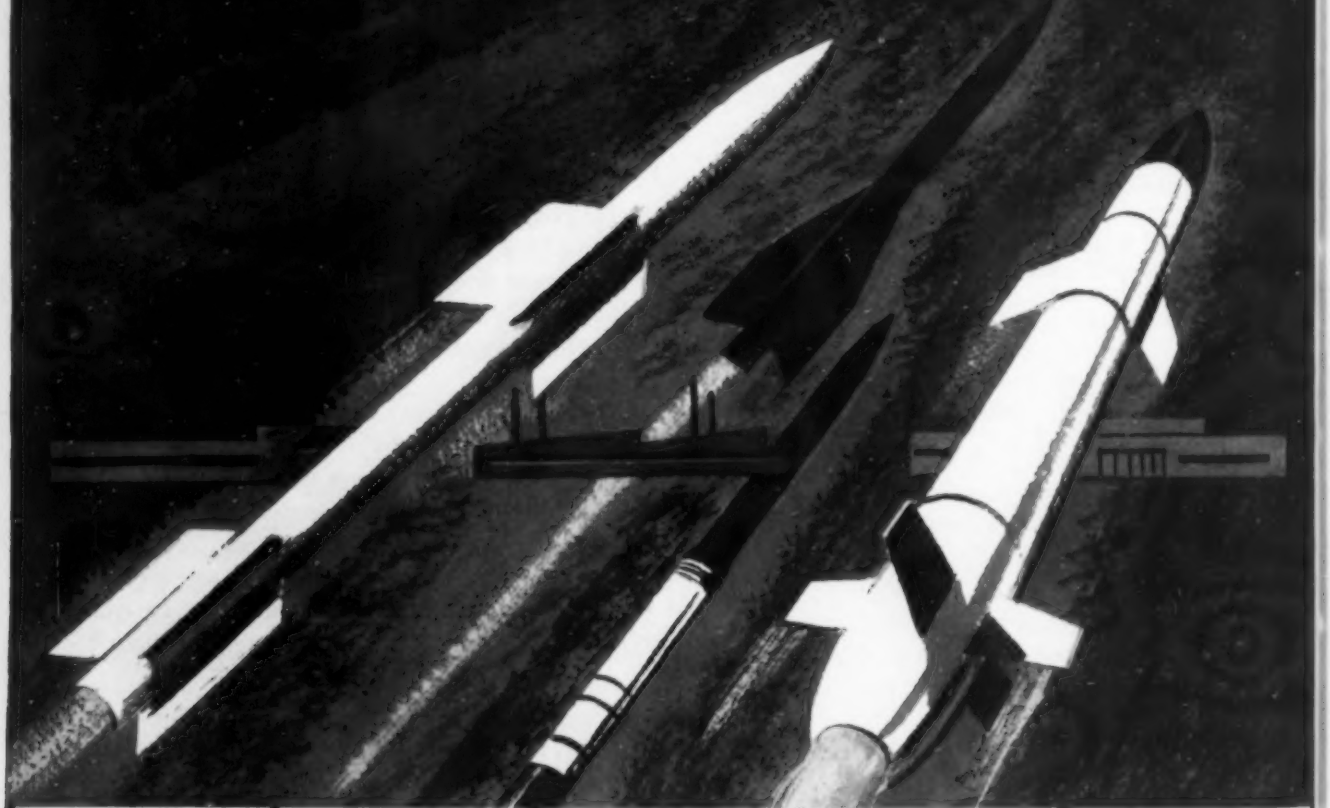

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. . . ARS abstracts

of Satellite Attitude Motions, Robert Roberson, (722-58).

Composite Trajectories Yielding Maximum Coasting Apogee Velocity, Stanley Ross, (723-58).

Electric Arc Gas Heaters for Re-Entry Simulation and Space Propulsion, Thomas R. Brogan, (724-58). Describes the development and calibration of an arc-powered wind tunnel designed to provide steady flow simulation of the conditions encountered during re-entry.

Missile Control Systems, D. T. Sigley, W. Hostetler & E. W. Ford, (725-58).

An Approach to Predetermination of Reliability, P. F. Winternitz & L. V. Toralballa, (726-58).

A Servo System for an Air Bearing Gyro Stabilized Platform, R. C. Martin, (727-58).

Matching Auxiliary Power Supplies with Missile Control Requirements, H. J. Howard, (728-58). Discusses means of selecting an auxiliary power supply best fitting needs of a typical missile control system.

Some Structural Aspects of Orbital Flight, George Gerard, (729-58).

Brazed Sandwich Structures for Missiles and Space Vehicles, Richard S. Mueller & George D. Cremer, (730-58). Purpose is to apprise today's capabilities in the field of braze joining, with emphasis on high-temperature, corrosion-resistant brazing applications.

Buckling of Unstiffened Thin-Walled Cylindrical Shells Subjected to Various Loading Conditions with and without Internal Pressure, Bertram Klein, (731-58). Reliable and simple design curves are presented for determining the allowable buckling stresses of the subject structures.

Structural Considerations of Manned Space Vehicles, Anthony P. Coppa, (732-58). Gives approaches leading to an optimum vehicle, considering the requirements of thermodynamic and human factors, in addition to structures.

Structures for Space Craft, Paul E. Sandorff, (733-58).

Contour Nozzles, Ellis M. Landsbaum, (734-58).

General Technical Report on the Experimental Liquid-Propelled Rocket, The DREX-3, Charles R. Meldum, (739-58). Analyzes mechanical operation and component structure of the experimental rocket built at the University of Detroit.

Inertial Guidance, Bert W. Hilburger, (741-58). Consists of a brief resumé of the subject, as it exists today.

This is one of a series of professionally informative messages on RCA Moorestown and the Ballistic Missile Early Warning System.

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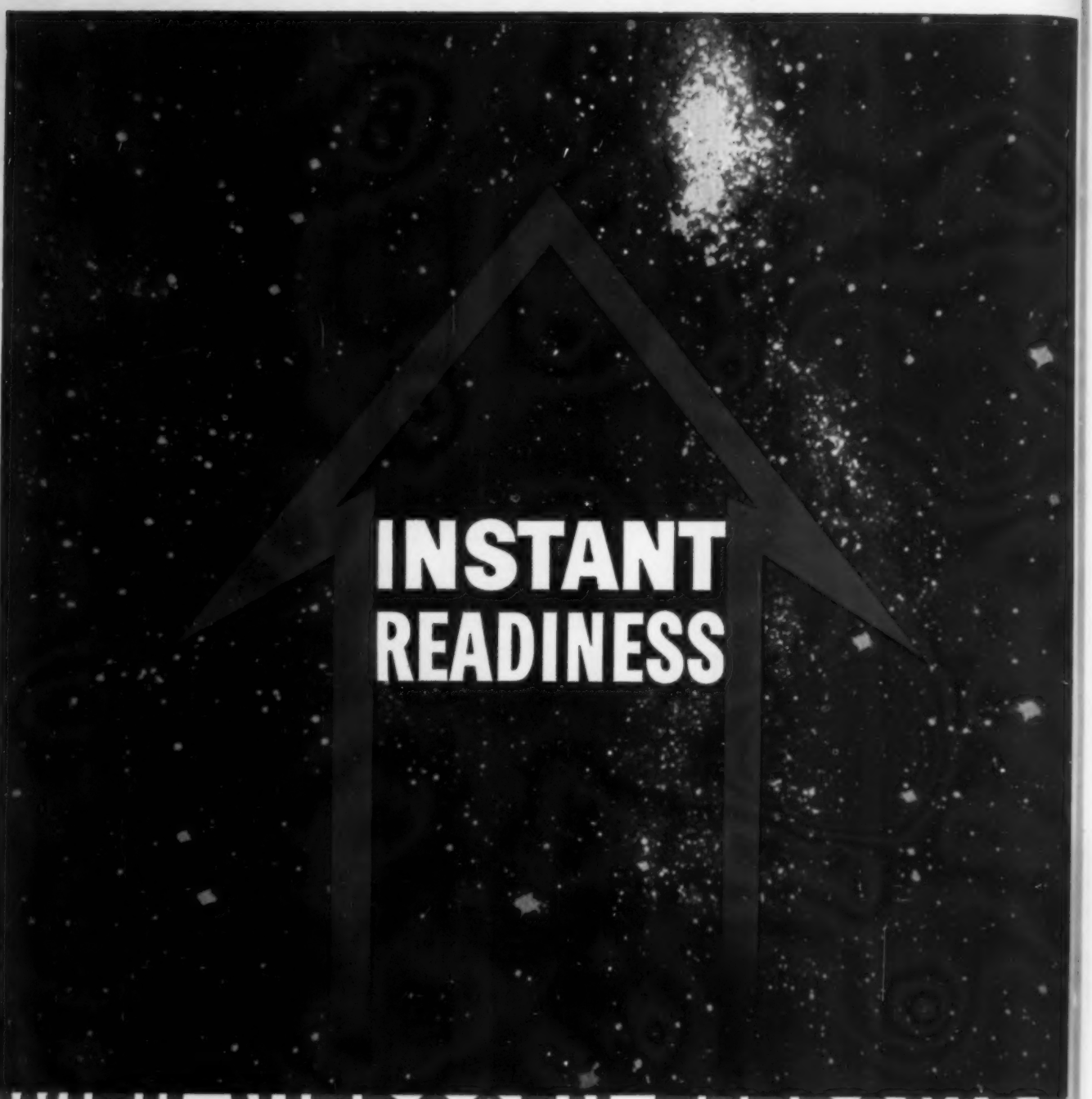

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Industry is pioneering new methods to form better steel alloys in casings to advance solid propellant missiles beyond present state of the art.

Motor Development Depends on Alloys

by Norman L. Baker

WASHINGTON—The rate of advancement of U.S. large solid propellant ballistic missiles is currently controlled by the state of the art in motor materials development. This control will continue to exist until major improvements have been made in materials, motor unit design, and fabricating techniques.

Basically the problem is one of improving the quality of current steel alloys and finding new and better methods of forming and fabricating. In the past, such problems were the responsibility of our large steel industry. But here is where the real problem begins. The tonnage of steel currently required for the nation's entire missile program apparently is too small to secure the sincere research interests of the steel industry. Therefore, responsibility has been placed on the smaller metal working firms, many with years of experience in light-walled high pressure vessels.

• **Large grain development**—For example, Thiokol Chemical Corp., for many months has been engaged in a development program directed toward achieving motor chamber designs of the lightest possible weights for the *Minuteman, Pershing* and *Polaris* weapons systems. Thiokol has called upon several organizations that have in the past contributed greatly to the current state of the art in case manufacture. Some of these companies are:

1) Borg Warner Corp., Ingersoll-Kalamazoo Division
2) M. W. Kellogg Co.
3) Excelco Developments, Inc.
4) Jet Division, Thompson Products, Inc.
5) Diversey Engineering Co.
6) Scaife Co.
7) Curtiss-Wright
8) Solar Aircraft

During this development program large diameter motor cases of 28, 31, 54, 60, 62, and 70 inches have been rigorously analyzed. Surveys of existing materials have disclosed that steel, formulated specifically for high yield strength casings is not readily available. It was found that hot-work-die steels closely approximate the properties and requirements but demand highly refined techniques of metal manufacturing and fabrication.

Recent developments indicate a successful solution to the fabrication problem on a small scale, although a major effort will be needed before these techniques can be incorporated into a practical and reliable production

COMPLETED SOLID PROPELLANT motor case for the *Nike-Hercules* sustainer at the Scaife Co. plant. In background is 1500-tone hydraulic press for deep-drawing.

FORWARD THRUST ATTACHMENT of *Matador* TM-76 booster is jigged for insertion into the fixture in special drill pit. Fixture assures proper bolt alignment.

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The system concept demonstrated in the "Sergeant" has permitted excellent mobility and speed of operation to be attained. The requirements of the Army have been stressed, resulting in outstanding characteristics of the weapon meriting the title of "America's first truly 'second generation' surface-to-surface tactical missile."

The responsibility for accomplishing this important achievement has been placed on JPL by the United States Army Ordnance Missile Command.

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method.

Several methods of fabrication are being investigated. Each method has required a materials evaluation program to select the steel that can be most efficiently adapted to the method of fabrication. The most promising methods are roll-and-weld, deep-draw, power-spin, helical-weld, vacuum-weld and strip or ribbon spiral-wrap.

One of the firms working under Thiokol subcontract that has been selected to conduct further development efforts on a concurrent basis is the Scaife Co. of Oakmont, Penna.

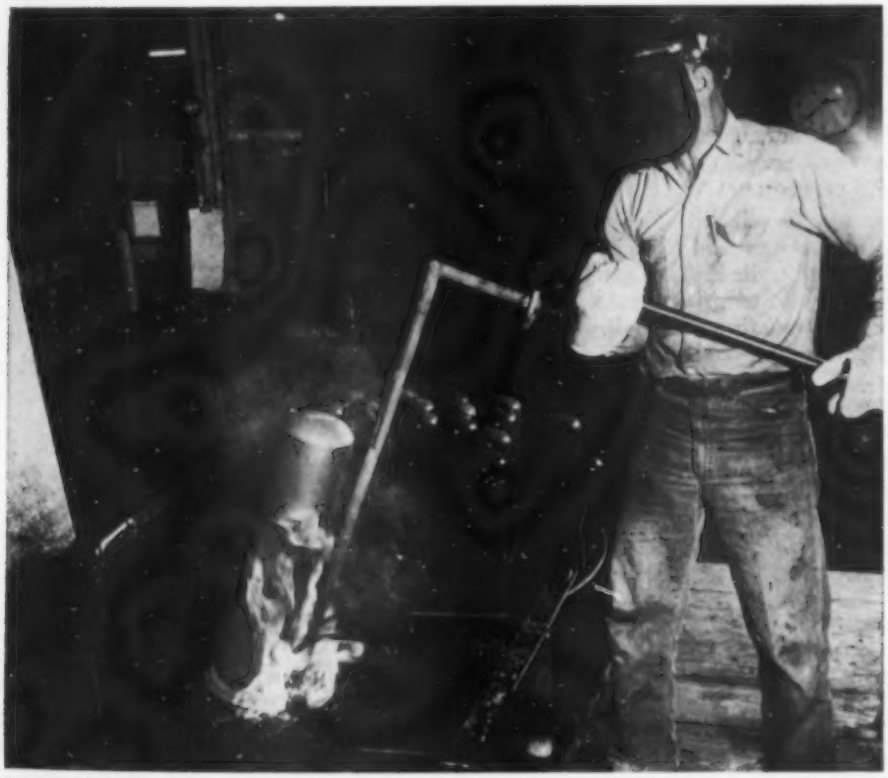
Scaife, a pioneer in the development of deep-drawn motor cases, has maintained a multiple metal working fellowship at the Mellon Institute in Pittsburgh, assuring an unusual and highly competitive position in the field of advanced metal parts processing and development techniques. It was recently reported (m/r, Nov. 17, p. 9) that Mellon Institute had fabricated rocket motor cases that were tested to a yield strength of over 225,000 psi. The Air Force and Navy are asking for *Minuteman* and *Polaris* motor cases with yield strengths from 210,000 to 240,000 psi.

• **Material requirements**—Current missiles have solid propellant motor cases fabricated from steels comparable to AISI-4100 to yield strengths up to 160,000 psi. The larger casings for the *Minuteman* and *Polaris* have demanded a great reduction in the weight of the casing wall and metal parts (nozzle, heads, rings, etc.). This requirement has made it mandatory that high strength steels such as AISI-4340 or H-11 hot work tool steels be incorporated as motor material.

Experience with the production of *Hawk, Nike-Hercules,* and *Matador* motor cases has enabled Scaife to participate in the current development of the large grain motor bodies for IRBMs and ICBMs. The production of the smaller motor cases required the use of deep-draw, hot and cold spinning, hot extrusion, cold sizing, automatic and semi-automatic inert shielded arc welding and heat treating to strength levels in excess of 200,000 psi. The same techniques were employed in the construction of motor cases and other components of the *Polaris-B* missile system. This case was 38 inches in diameter.

Scaife is currently engaged in the development of wall motor cases for an operational long range solid propellant ballistic missile. The program is employing the techniques of deep-draw and helical weld while a parallel program is employing the helical welded case construction.

The deep-draw program involves the evaluation and development of suitable high strength materials, specifications for the materials, and the establishment of forming techniques for the side walls, head, and aft end. The



DEEP-DRAWN *Falcon* **motor case being oil-quenched before heat treating operation.**

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For more information, write today for Bulletins R250 and S260. For quick facts about "Diamond H" switches, thermostats and other devices, ask also for a copy of the "Diamond H" Check List of Reliable Controls.

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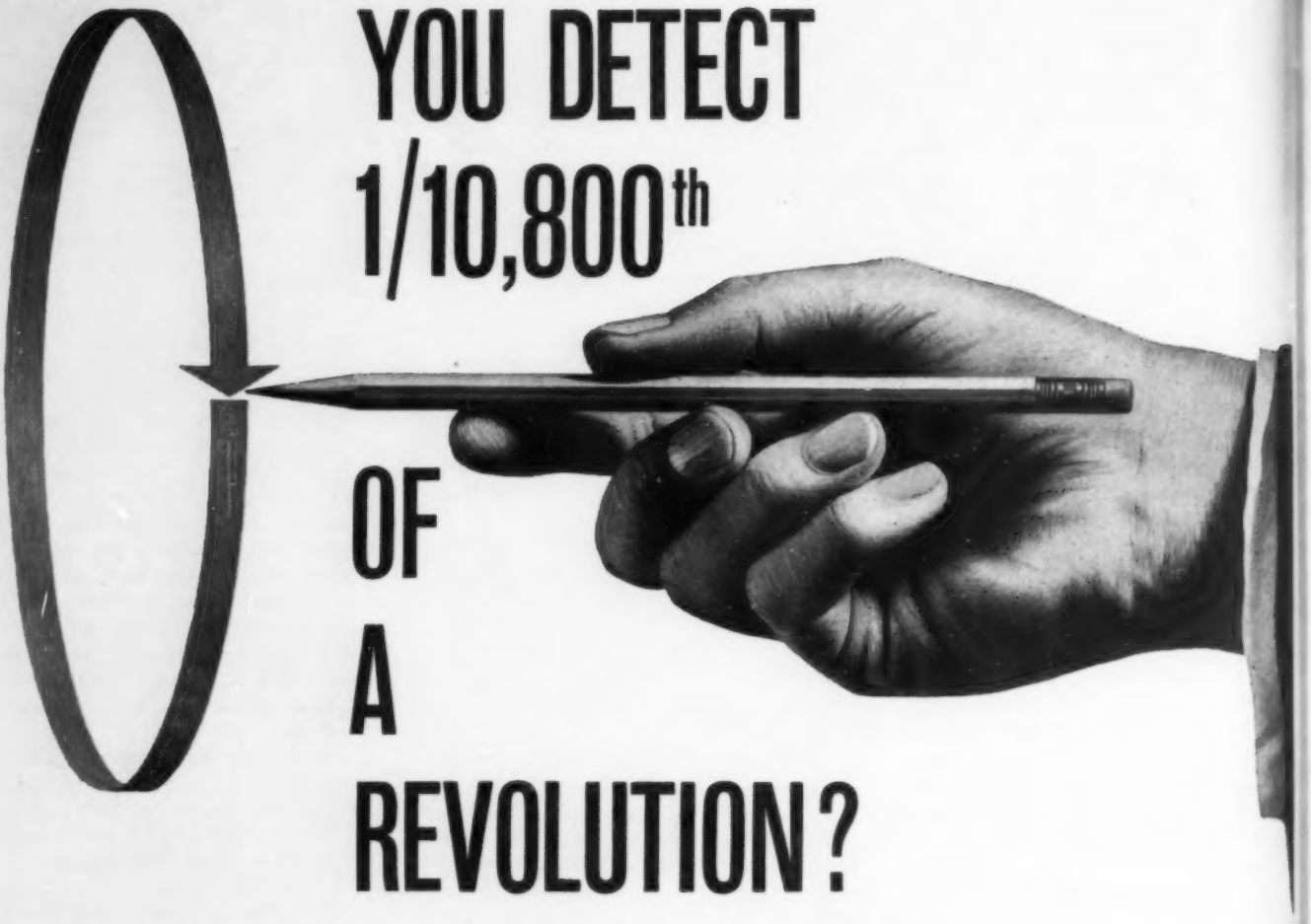

Detecting microscopic shaft movement of as little as 2 minutes —well beyond the ability of most standard synchro units— can now be accomplished with new synchros designed and produced by Ketay, and available for immediate delivery. Such increased accuracy, three times better than the highest Mil Spec requirements, is the result of Ketay design and production competence.

Ketay has also developed a complete line of improved thru-bore synchros to the new Mil Spec 20708 (supersedes Mil Spec 16892). These improved units are available at no increase in cost in a full line of control and torque types, with frame sizes from 08 to 23. Thru-bore construction and stainless steel housing make them more rugged and more reliable as well as providing better accuracy and greater stability. *Ketay is the only approved Bureau of Ordnance source currently manufacturing and shipping all these units.*

Ketay research and development engineers are regularly working on advanced new components and prototype control system problems for the armed forces and leaders in the aircraft and missile industry. Let them help solve your special problems in component performance and environment adaptability.

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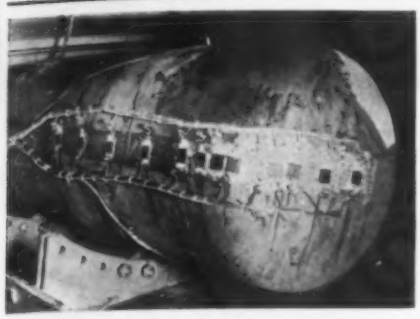

TESTING of high-yield strength deep-drawn motor case using strain gauges.

assembly of these components by a welding operation has received a parallel development effort.

Scaife, with present machinery, can deep draw cases up to 56 inches in diameter and 42 inches in length. The dimensions can be exceeded by modification of the existing machinery according to company officials. If the diameter does not exceed 56 inches, length of the motor units can be increased simply by butt-welding the drawn cylinders.

• **Deep-draw technique**—In the deep-draw process, a circular sheet of metal is pressed and drawn into a seamless cylindrical cup with the side wall thickness held to within a very few thousands. Two of the cups are then machined to the desired length and butt-welded. If a greater length—than can be obtained with two cups—is required, the spherical end of as many cups as needed is trimmed off and the open tube is welded into place. The joined case is then heat treated to the desired strength level.

The assembly is again machined and certain non-pressure components are attached. The completed unit is given a special treatment to protect it against hydrogen-embrittlement after the final machining. During testing, strain gauges are attached to various sections of the case to determine the magnitude and distribution of stresses. Finally, the case is subjected to a hydrostatic test.

Although the large (1500 and 750 ton) hydraulic deep-draw presses are the most outstanding pieces of equipment in Scaife's manufacturing facilities, the rest of the production layout reflects a highly specialized and diversified production capability. Equipment includes blanking and forming presses; planers, lathes, milling and other machine tools; shot and sandblast; pickling and cleaning; welding; heat treating; and forging and extrusion equipment.

Six categories of research are also carried on by Scaife.

Major Southern California missile operation has

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with general knowledge of missile systems, including propulsion, guidance, structures and electrical systems.

Guidance Systems

Experienced in research and testing of practical hardware, and with mathematical background for systems analysis.

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Background should qualify for planning and formulating entire flight test programs.

Aerodynamics

Must be able to analyze missile configuration to determine aerodynamic performance and stability and control characteristics.

For information on these and other engineering positions, write:

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Missile Division
North American Aviation, Inc.
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Gas Turbine Compressor Power Unit. Multiple engine starting, ground electronic cooling, electrical and hydraulic power, trailer or pod mounted.

AiResearch Gas Turbines are used in hundreds of applications: auxiliary power and ground support for missile systems, military and commercial aircraft; main engine starting, electrical and pneumatic power, air conditioning, pressurization, pre-flight check-out, snow and ice removal; prime power for helicopters; variety of ground applications or aboard aircraft for mobile or stationary use.

Advantages: these lightweight units are air transportable as fixed installations, detachable pods or portable vehicles; supply low pressure air and shaft power from 30 H.P. to 850 H.P.; provide variety of electrical power – 9 to 150 KW, 60, 400 and 1200 CPS, AC or DC; have highly refined self-regulating controls and operate in any weather; have instant push-button starting; time between overhauls 1000 hours or 3000 starts.

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New Concept In Data Handling Equipment

Telemetering units developed by Applied Science Corp. analyze data before transmission to ground equipment.

by Raymond M. Nolan

PRINCETON, N. J. — Telemetering equipment employing a new and advanced concept of statistical data handling has been developed by the Applied Science Corporation of Princeton (ASCOP).

The new equipment promises more efficient handling of data on missile and aircraft performance by statistically analyzing the data and extracting its significant information content for transmission, recording and analysis.

Principal advantages offered are conservation of telemetering bandwidth, reduction in the weight-to-data ratio of airborne equipment and a marked decrease in data reduction and processing time.

The first units of this statistical data handling line are small, light, solid state airborne devices for analyzing high-frequency (vibration-produced) random data.

Since the outputs of the devices are essentially low frequency, slowly varying information content in standard IRIG D.C. signal form, the analyzed data can be transmitted by any standard telemetry system, such as PWM/FM or PAM/FM/FM etc., with resulting saving of bandwidth.

In addition, the new statistical devices save weight by reducing the required number of high-frequency, multi-transmitter installations in an airborne vehicle. Data reaches the ground in pre-analyzed, meaningful form. In many cases, no further computation or processing is necessary.

The three airborne devices are:

Airborne Spectrum Analyzer—Transistorized models weigh less than 7 ounces and occupy less than 25 cubic inches. The analyzer will accept 5-volt peak random time-history signals covering the band from 1 to 10,000 cps. and convert them into an output X-Y plot where the X-coordinate is proportional to the frequency and the Y-coordinate is proportional to power.

The output is a standard IRIG 0-5V. The analyzer is a swept type where a narrow bandpass filter is used to divide the frequency bandwidth of the input signal into equal intervals.

Amplitude Probability Analyzer—Fully transistorized models of this analyzer occupy only 20 cubic inches. The analyzer will handle random signal inputs with an amplitude range of –2.5V to 2.5V and a frequency range of 5 cps. to 25 kc. It provides an output of amplitude plotted against the probability that a given amplitude will appear in the random signal.

The output is in the form of standard IRIG 0-5V. The analyzer is basically a swept type which sweeps an "aperture" across the signal amplitude and analyzes the amplitude content at each level.

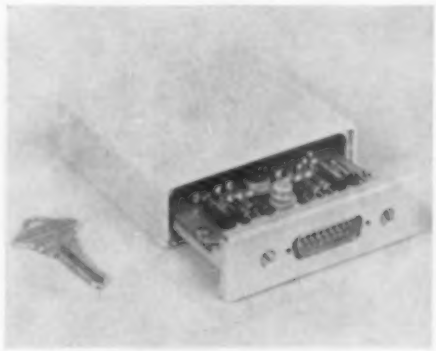
Time-of-Occurrence-Marker—The marker weighs 3 ounces and occupies 3 cubic inches. Although the marker is not in itself a statistical analyzer, it is an important member of the statistical data handling line because of its ability to accurately pinpoint occurrences such as transient phenomena, exceeding of limits etc.

The marker maintains an output signal of 5V minimum until it is actuated by a switch closure, transient, exceeding of limits etc. Then the output becomes a highly linear ramp function that starts from 0V at the instant the event occurs and rises back to the 5V minimum. By inspection of the ramp, the instant at which an event occurred can be determined with great accuracy.

ASCOP has also developed a larger, ground-based statistical unit which is known as a Transfer Function Computer.

Transfer Function Computer—The computer is a valuable tool

COMBINED SPECTRUM and amplitude probability analyzer, part of equipment.



TIME-OF-OCCURRENCE marker used with Statistical Data Handling Equipment.

SCOPE SHOWS output of spectrum analyzer, power vs. frequency, 4-second sweep.

3 completely new

GENISCO CENTRIFUGES

with 10 times greater accuracy, larger centrifugal capacities, maximum flexibility...*and priced lower than any other centrifuges now available!*

The low-cost answer to fast, accurate testing of components under simulated operational g-forces as required by MIL-E-5272A.

These new precision centrifuges feature a unique, high-torque ball-disc integrator drive system which provides accuracies you would expect only from a rate-of-turn table. Constancy of boom rotation, including wow and long-term drift, is better than .05% at any speed setting—approximately 10 times more accurate than currently available machines. Boom speed is infinitely variable and is measured by an electronic counter built into the console.

The building block design concept gives the new centrifuges exceptional flexibility. Machines are assembled from six basic off-the-shelf components; drive system, drive motor, boom, test compartment, console and accessories. You simply select components which provide features needed to meet your specific requirements. Interchangeability of the components permits easy modification as requirements change. Kits are available for modification by the customer.

This new design concept also results in manufacturing economies which are reflected in the cost of the machines. *The new machines are the lowest priced centrifuges now available—in spite of their greater accuracy, flexibility and capacity.* Ask your Genisco representative for complete information today.

There are more than 400 Genisco centrifuges now in operation.

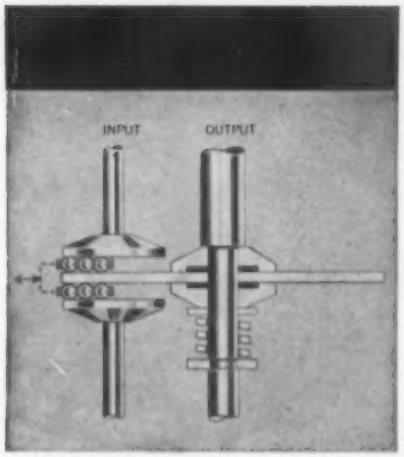
Genisco INCORPORATED

2233 Federal Avenue, Los Angeles 64, California

brief performance specifications

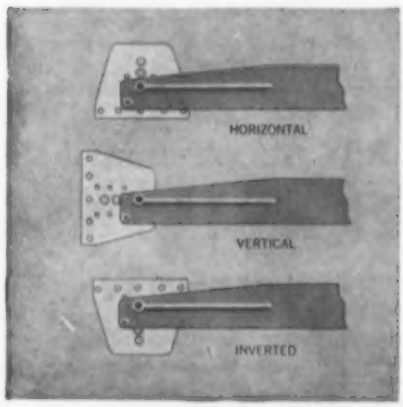
Model No.	Diameter	Test Object Weight	Capacity G-pounds	RPM Max.	G-Range Max.	Test Object Dimensions
A-1010	30" table	50 lbs. dead weight	2,500	800	.1 to 200 g's	
A-1020	60" arm	100 lb. dead weight	10,000	600	.1 to 250 g's	12" cube
A-1030	96" arm	100 lb. dead weight	10,000	400	.1 to 175 g's	18" cube

Large custom centrifuges: Genisco centrifuge experience includes the design, manufacture and installation of large custom-built machines. We invite your inquiry.



Entirely new, more efficient drive system—An integral variable speed transmission based on the new *Rouverol* *ball-galaxy principle achieves, for the first time in rotating machinery, high torque characteristics while maintaining the inherent accuracies of a hardened steel-to-steel ball-disc integrator. A novel choice of geometry among the drive elements results in a virtually linear handwheel vs rpm relationship, thus facilitating the presetting, programming and servo-controlling of output speeds. A built-in torque-limiter clutch protects the transmission from damage resulting from abuse or high inertia conditions.

*Pat. Pending



Basket-type mounting platforms, available on Model A-1020 and A-1030, may be oriented from the horizontal to the vertical or to the inverted attitude for multiple-axis testing without demounting the test object. Baskets may be raised or lowered to achieve an optimum dynamic balance and minimum angular deflections when extreme accuracies are required. When the basket is inverted the outside surface of the platform may be used to mount bulky, lightweight packages.

Available accessories include additional slip rings, servo control, microwave joints, high pressure air and hydraulic systems, TV viewing systems. Any accessory can be added *at any time* by the user. The mounting base is standard equipment.

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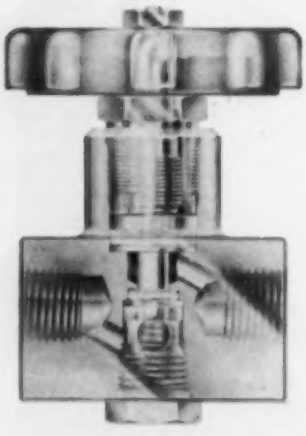

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. . . missile electronics

for determining the relationship between random noise-like input and output signals, such as the exact roles different phenomena play in affecting the final vibration of a missile or aircraft member. Various packaging arrangements are available, including standard rack and chassis construction.

The computer will handle noise-like signals containing frequency components from 0.1 cps, to 15 KC at a normal input voltage of 1V RMS. Its three identical spectrum analyzers and analog computer circuitry produce an amplitude and phase relationship between the two signals under analysis for all frequencies of interest. This can be plotted in several ways. For example, an X-Y plotter can generate a family of vectors, with one vector for each frequency of measurement. The resulting graph shows the amplitude and phase of the vectors.

The first pre-production units of the airborne devices are scheduled for delivery to customers in January, 1959.

The ASCOP development program is based on the fact that most high frequency data encountered in missiles is of the random nature. As such, it can be analyzed to give low frequency, slowly varying results, such as power frequency spectra, amplitude-probability distribution and correlations between various functions.

These are the same results which are now sought by time-consuming, costly analysis and computation of time-history plots transmitted to the ground, at a high cost of airborne transmission equipment and valuable bandwidth.

Other statistical data-handling devices, including a cross correlation computer, are currently under development. The ASCOP statistical data handling program has been backed by contract support from three leading military missile agencies.

Fairchild Semiconductor Corp. Expands R&D

PALO ALTO, CALIFORNIA—Fairchild Semiconductor Corp. announced construction of a new 65,000 square foot plant facility in nearby Mountain View to provide expanded space for production research and projects in new semiconductor materials and parametric amplification.

Occupancy of the new million dollar manufacturing plant is planned for May 1, at which time the present 20,000 square foot facility at Palo Alto will be devoted to expanded research

expected to result in greatly improved performance in long range surveillance radar, transmitters for space vehicles and very high speed electronic computers.

According to Dr. Robert Noyce, director of research, new materials being explored for possible use include the intermetallic compounds.

"Because of the variety of properties of these materials that may be tailored to a specific application, they have promise of extending the range of applicability of transistors to higher temperatures and higher frequencies as well as introducing semi-conductor devices operating on new principles," he stated.

"Parametric amplifiers using semiconductor diodes have given low noise performance at microwave frequencies, and, as a result are expected to find wide applicability in radar and communications," Dr. Noyce added.

Until completion of the new plant, production of present products is being handled at Palo Alto. By the end of 1959, Fairchild Semiconductor expects to have a total of 650 employees.

Camera Pick-up Tube "Heart" of New Telescope

The heart of a new opto-electronic telescope, developed by the U.S. Air Force, is a new camera pick-up tube, perfected by the Westinghouse Electric Corporation's electronic tube division, Elmira, N.Y. This new tube is three to four times more sensitive to white light than tubes previously used for telescopes. Because it is particularly sensitive to longer wave lengths in the spectrum from yellow to red, the Westinghouse tube can produce daylight pictures of the moon and planets never before possible.

The opto-electronic systems was conceived by Radames K. H. Gebel, a civilian scientist at the Wright Air Development Center's Aeronautical Research Laboratory in Dayton, Ohio. It is now in operation in the Weaver Observatory at Wittenberg College in Springfield.

Gebel and Dr. Lloyd Wylie, professor of astronomy at Wittenberg College, have already used the telescope to produce a composite photograph of the full moon which is made up of more than 200 separate pictures. Forty inches in diameter, the composite picture shows details invisible to ordinary photography methods. For example, the rays of the crater Tycho cannot usually be seen at full moon, but are readily distinguishable with the telescope employing the new Westinghouse tube.

Another advantage in getting a direct view of the full moon, Gebel

Shown 1/18 actual size

How missile designers can use HACKNEY deep drawing methods

Shown here are a few shapes, shells and missile components produced at production-line speed by *Hackney Deep Drawing Methods.* They were designed to reduce weight without sacrificing strength, save production or assembly time, and lower costs.

If you wish to consider *Hackney Deep Drawing Methods,* keep in mind the following specifications and the fact that our engineers are available for consultation at any time.

Shapes: Cylindrical, spherical, conical or tapered.

Capacities: From 1 quart to 100 gallons.

Diameters: From 3 inches up to 32 inches.

Depths: Up to 110 inches. Two half-shells are easily welded for extra length or symmetrical design. Open ends can be closed by spinning to give an entirely seamless cylinder.

Blank thicknesses: 16 gauge and heavier.

Wall thicknesses: For working pressures up to 5000 psi in smaller diameters, up to approximately 400 psi in larger diameters.

Metals: Steel, stainless steel, nickel, aluminum, magnesium, copper and many alloys.

Send sketch and details of your problems to our Engineering Department.

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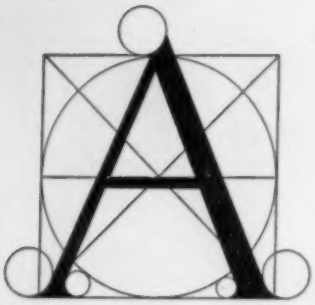

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Litton Industries offers research appointments of the highest order of importance to the nation's defense and economic endeavors. Applicants must have proven capability at the professional level for contributions toward the advancement of knowledge in the fields of computation, guidance, communication, or control.

In the field of Space Research, appointments will be made within the disciplines of astronautics, bioastrophysics, basic physics, and hyperenvironmental testing.

These few men will have as their resources the skills of any of a thousand people who are the life of the electronic complex which is the Electronic Equipments Division of Litton Industries. They will command the most advanced computational instruments as their tools, plus the only Inhabited Space Chamber in the free world, plus engineering and manufacturing facilities which produce complete systems.

The locale is Southern California where both the physical and intellectual climates are to be enjoyed. Send a brief resume to G. L. Dawson, Litton Industries, Electronic Equipments Division, 9261 West 3rd Street, Beverly Hills, California.

LITTON INDUSTRIES
Electronic Equipments Division

points out, is the freedom from distortion that goes with photographing at oblique angles. In the past, pictures have had to be taken when the moon's lighting was oblique so that shadows would produce sufficient contrast.

The opto-electronic telescope operates essentially as a closed circuit television system. Images picked up through the telescope are transformed into electrical impulses by the camera tube, and are made visible on a cathode ray tube after passing through a video amplifier. Photographs are then made from the face of the picture tube.

New RCA Unit Formed for Advanced Research Studies

A new high-level scientific and technical organization known as Advanced Military Systems has been established by RCA to create and develop new and advanced weapon system concepts, Arthur L. Malcarney, executive vice-president, RCA Defense Electronic Products, announced recently.

Describing the purpose and function of Advanced Military Systems, Malcarney said:

"The creation of modern weapons in the new age of missiles and space technology, has become more and more a matter of conceiving and developing intricate technical systems. These draw upon our advanced scientific technology and require the highest calibre of engineering skill. In line with this trend, and in view of its current responsibilities as a major contributor to our national security, RCA has formed Advanced Military Systems to 'spearhead' studies leading to the creation of new, complex and ever more effective weapons systems.

"This group is the culmination of many years of evolution in the field of systems engineering at RCA. The philosophy of conceiving and delineating complex military systems has been tested and proven on such programs as Ballistic Missile Early Warning System, airborne fire control, long range communications, and Land Based Talos.

"The objectives of the group will be first to determine the need for specific types of systems to meet specific requirements, and then to originate detailed proposals or 'blueprints' upon which such systems may be based.

"We feel that the organization of Advanced Military Systems, added to the extensive scientific and technical resources already possessed by RCA in its various divisions, will prove to be of major importance to the ad-

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vancement of our technology and the maintenance of national superiority in offensive and defensive weapons systems during the years to come."

Malcarney pointed out that the new group will function in close cooperation with all segments of RCA engaged in defense work, including the RCA Laboratories.

Lockheed Develops New Energy Conversion Method

SUNNYVALE, CALIF., Nov. 17—A method for converting chemical energy directly into electrical power, which could make quite a change in conventional propulsion systems, is in advanced development at Lockheed Missile Systems division laboratories.

L. Eugene Root, Lockheed vice president and general manager of the missile division, today described a "fuel cell" on which Lockheed scientists are working which has attained high efficiencies in electrochemical conversion.

He said that Dr. Morris Eisenberg, who is directing work on fuel cells, "has repeatedly achieved in laboratory experiments almost 100% of "fuel" utilization and energy conversion efficiencies of 70% or better."

This compares with a steam engine which has a conversion efficiency of 35 per cent and an internal combustion engine which is even less efficient.

SCIENTIST IN Lockheed Missile Systems division's electrochemical laboratory, demonstrates how a fuel cell converts energy directly into electrical energy to power motor which spins plastic disc.

Eisenberg predicted that a fuel cell which would "yield sufficient energy for powering an auto or even a plane could be developed within five years."

Eisenberg said some of the other possible applications, both scientific and commercial, include providing power sources for:

Communications systems and other internal equipment in a spacecraft requiring a long-lasting power supply.

Operation of scanning and recording equipment in such scientific space projects as lunar probes.

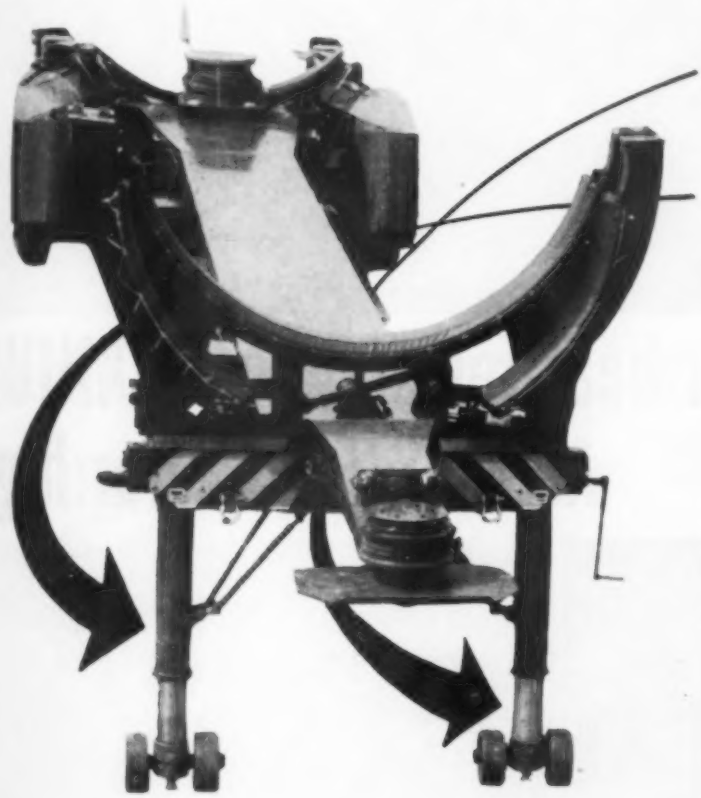
Comparing the fuel cell with the lead acid battery, Eisenberg explained that the basic difference is that in the battery the active materials are inside the case.

"In the fuel cell the electrochemical fuel is stored outside so the components of the cell are not consumed in the electrode reactions," he said.

Energy produced by electrochemical reaction is measured in watt hours per pound of total weight. An automobile battery, for instance, yields between 8 to 10 watt-hours per pound.

By way of contrast, Eisenberg said, a fuel cell presently being developed is designed to produce 100 watt-hours per pound and predicted that one of 300 watt-hours could be developed within five years.

"Even a 150-watt-hour-per-pound cell would produce enough energy to power every type of aircraft or space-



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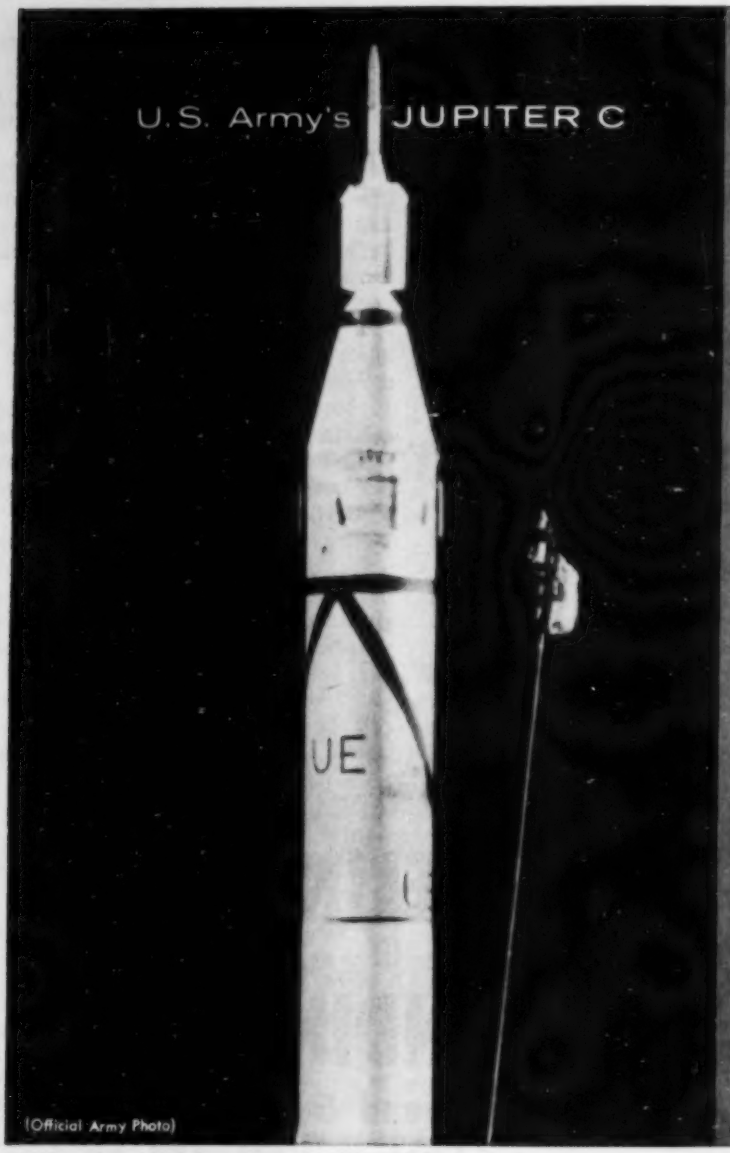

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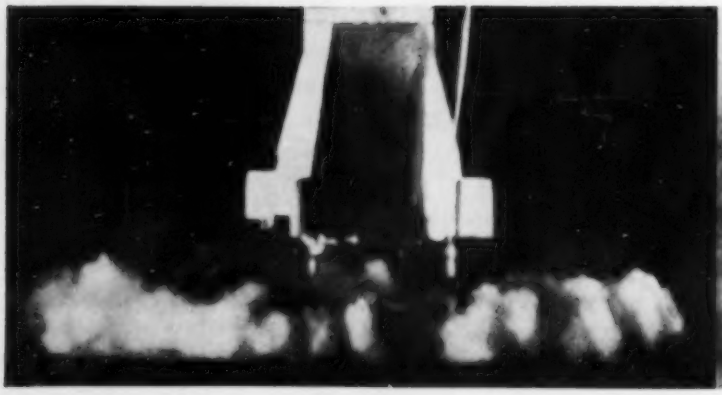
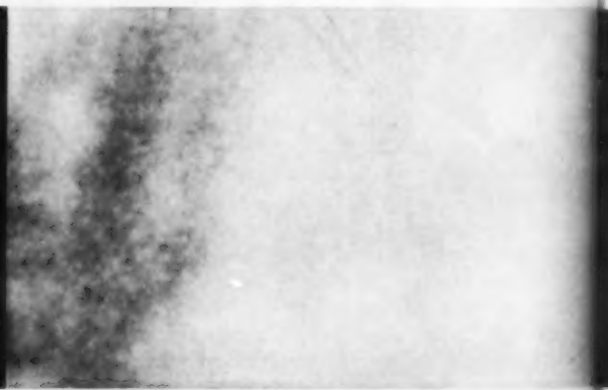
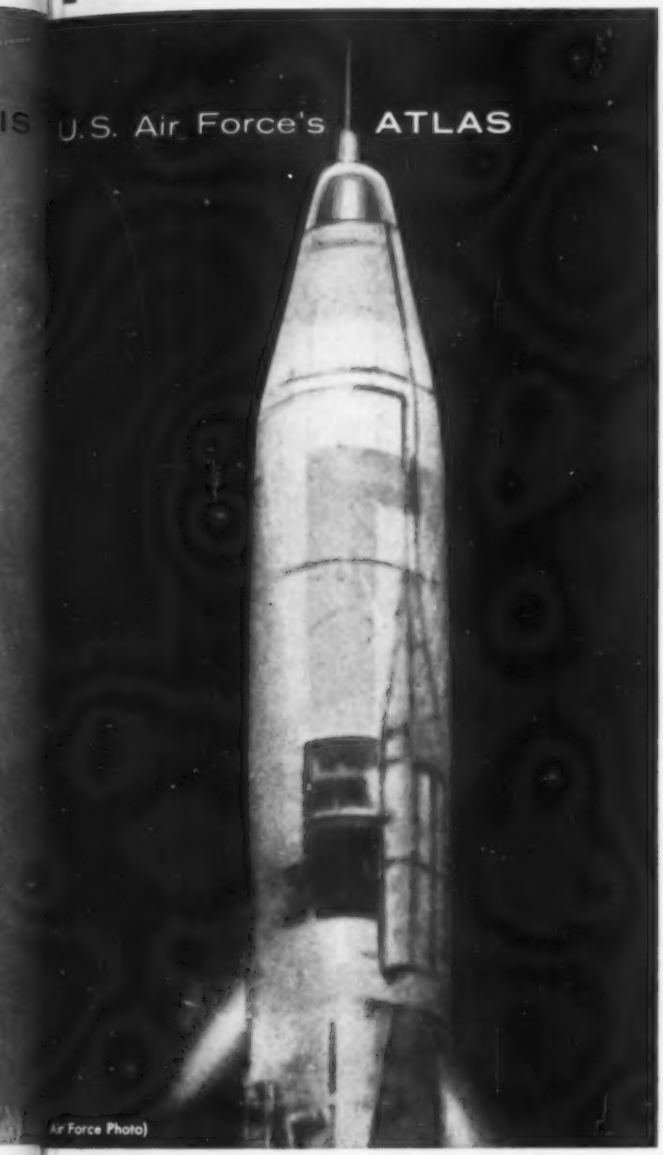




st producer of Missile Metals



JM for weight reduction gh strength

Many types of missile metals are required to meet the severe demands of the space age. Metals to resist heat, to reduce weight, to add strength. Production of these flight weight metals is a Republic specialty.

Stainless steel protects missiles and rockets from the searing heat of air friction. Titanium alloys offer the highest strength-to-weight ratio of any construction metal. Republic produces both of these metals in billets, hot rolled and cold finished bars, plates, sheets, and strips.

Republic Alloy Steels are continuing to play a prominent part in the development of operating and structural parts free from excess weight, yet tough and strong to withstand shock, impact, strain, and vibration.

As rapid development in the missile field increases demand for these high-strength, select formula steels, Republic is keeping pace through research and new production facilities.

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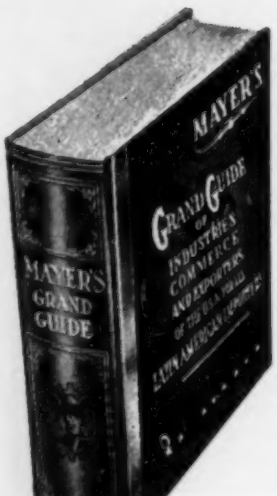

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craft and to provide power for communication in satellites and space vehicles," he declared.

As to the possibility of the fuel cell replacing the internal combustion engine in automobiles, Eisenberg said it would take only an 80 watt-hour-per-pound cell to excite Detroit's automotive engineers and designers.

Major advantages of the fuel cell, according to Eisenberg, include long operating life, adaptability to both large and small-scale applications, no noise or fumes and ease of maintenance since there are few moving parts.

Miniature Tape Recorder Stores 3 Million 'Bits'

PALO ALTO, CALIF.—A tiny rugged tape recorder capable of storing three million pieces of scientific data as it travels through outer space, has been developed at Lockheed Missile Systems division's research laboratory here.

Small enough to be held in one hand, the unit answers the need for a lightweight versatile communication unit for scientific space missions.

Mark Siera, research scientist in Lockheed's telecommunications department, who developed the AMR-100 (for Airborne Magnetic Recorder) said it is a valuable piece of equipment for lunar probes, manned and unmanned spacecraft, and for interplanetary vehicles.

It can record and store vital data of the universe during long intervals when an interplanetary spacecraft is out of direct radio contact with the earth and then transmit it at an accelerated rate on a command signal when the vehicle returns to within range of the earth's listening posts. It

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can unload its accumulated information in one-sixth the time it takes to record it.

The recorder has survived simulated rocket launches of 50 times the force of gravity, the Lockheed scientist said.

The compact unit, weighing only eight pounds and measuring nine inches long, five inches high and 4½ inches wide, is one-third smaller than existing recorders with the same capacity. It can function at unlimited altitudes and in any position or axis.

An unusual Lockheed-developed feature, now being patented, is an easily changeable cartridge containing a 600-foot endless loop tape which records two tracks of information simultaneously.

Data is accepted periodically on command and reproduced at six times the recording speed upon another command.

"For instance," Siera said, "48 minutes of continuous recording can be reproduced within eight minutes. The tape can be started or stopped in a fraction of a second, thereby keeping wasted tape footage to a minimum."

The instant after the recorder unloads its data via telemetry to a ground station, it is immediately ready to begin storing new information.

Another feature of the device is the low power input required to operate it. Fully transistorized, only 10 watts is needed for the entire electronics system. In addition, the system is designed so that the power is turned on only when the recorder is in actual operation.

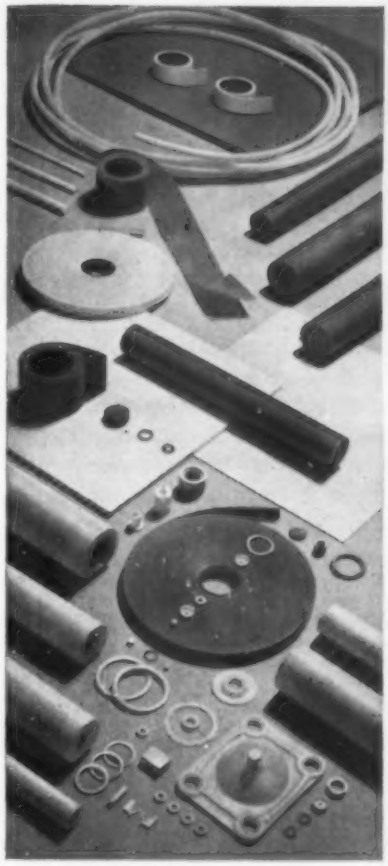
EIA Workshop to Cover Proprietary Information

A one-day workship on proprietary information will precede the Electronic Industries Associations winter quarterly conference in New York City December 2-4.

Sponsored by the association's Patents and Copyrights Committee, Military Relations Department, the workshop will examine practical approaches for handling proprietary information under government contracts to protect the contractor while meeting the government's needs for second source information, and adequate data for maintenance and repair.

"Proprietary information and its relation to work under government contracts has been a difficult problem," said workshop chairman Elmer J. Gorn of Raytheon. "Few companies appear to have developed a practical set of policies and practices which can serve as a day-to-day guide."

The four-session workshop study



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The Division is systems manager for such major, long-term projects as the Air Force Earth Satellite, Q-5 and X-7; Army Kingfisher; Navy Polaris IRBM and other important research and development programs. It was honored at the first National Missile Industry Conference as "the organization that contributed most in the past year to the development of the art of missiles and astronautics."

Responsible, high-level positions are available for experienced personnel in the following:

Electronics B.S. in E.E. or equivalent, with experience in one or more of the following: telemetry; instrumentation; radar and communications including radio, radio telephone and high speed teletype; VLR trajectory tracking.

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Flight Test Evaluation Advanced degree required in A.E., M.E., E.E., physics or math with minimum 5 years' experience in one or more of the following: technical control of missile systems tests; analysis and evaluation of missile systems performance; preparation of systems reports; missile flight test activities in blockhouse, countdown and launching operational performance evaluation. Liaison with the military is an important part of these assignments.

Flight Test Operations B.S. in A.E., M.E. or E.E. with 5 years' experience in missile flight test operations for blockhouse, countdown and launching activities. Liaison with the military is an important part of the assignment.

Theoretical Physics M.S. in physics required, Ph.D. preferred, with experience in space physics, or nuclear physics applications; infrared and other detection methods, with ability to evaluate flight test program effectiveness.

■ **For Information** regarding these and other related positions, please write: Research and Development Staff, Dept. 2211, 962 W. El Camino Real, Sunnyvale, California.

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will deal with these aspects of the problem: a definition of proprietary information, headed by Robert V. Faragher of RCA; an interpretation in practical terms of the recently issued Part 2 of ASPR IX (Technical data), under Ben Edelman of Westinghouse; preparation for contract negotiations involving PI, headed by Roe McBurnett of General Electric, and techniques for monitoring the handling of proprietary information within the contractor's organization, headed by committee chairman Gorn.

What the new Defense Education Act will mean to the electronics industry will be detailed at a luncheon December 3 by U.S. Assistant Commissioner of Education for Research, Dr. Roy Hall.

The following legislation, due to come before the new Congress which convenes in January, will be taken up by committees at the conference:

—The Saltonstall bill which would extend the weapon system concept to all large military systems and exempt incentive fixed-price contracts from renegotiation. Questionnaires have gone out to the members of the Systems Management Committee to assess the effect of the weapon system concept on small business and its effect on management efficiency.

—Indemnification legislation which would permit the Defense Department to insure its contractors against unusually hazardous risks. Although similar legislation was introduced in the last session of Congress, it was not reported out of committee in time for action before adjournment.

—Renewal of the Renegotiation Act.

Talos Shown in New York at Electronics Exhibit

The supersonic, surface-to-air *Talos* missile is the top attraction at a new display of electronics developments recently unveiled at RCA Exhibition Hall in New York City.

The exhibit features both new major defense and consumer electronic products. It includes a basic-relief map of the 5,000-mile Atlantic Missile Range—from Cape Canaveral to Ascension Island in the South Atlantic, and a miniature model of the FPS-16 missile-tracking radar system.

Talos, built by Bendix Aviation Co. is used on Navy warships.

The missile was hoisted by derrick through an exhibition hall window, in two sections: The booster, 10 feet long and 30 inches in diameter, weighing 1,000 pounds is a solid fuel rocket

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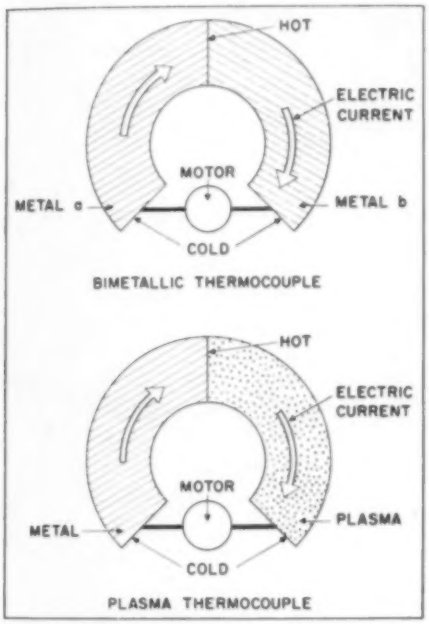
which is jettisoned after propelling the warhead section faster than a bullet. The warhead section—is 20 feet long, weighs 2,000 pounds, and when in use, contains a 40,000-horsepower ramjet engine.

Plasma Thermocouple Developed at Los Alamos

A plasma thermocouple, which can convert nuclear reactor heat directly into electricity to power instruments in artificial satellites has been developed by the Los Alamos Scientific Laboratory. The new generator which has no moving parts, is expected to be the forerunner of a nuclear reactor-plasma thermopile which would produce electricity through atomic fission.

Developers of the new generator, who are currently working on tests



SKETCHES SHOW the essential differences between two kinds of thermocouples.

for the thermopile, are G. M. Grover, William Ranken, D. J. Roehling, E. W. Salmi and R. W. Pidd, consultants to the laboratory from the University of Michigan. Theoretical analysis of the plasma thermocouple was developed by laboratory consultants, J. R. Reitz of Case Institute and H. W. Lewis of the University of Wisconsin.

The new thermocouple uses an electric plasma—a "fourth state of matter." While thermocouples usually use two kinds of metal fused together, this one uses only one. The other is replaced by the plasma, an ionized gas.

In addition to its use in satellites, other applications include interplanetary propulsion and current for consumer use.

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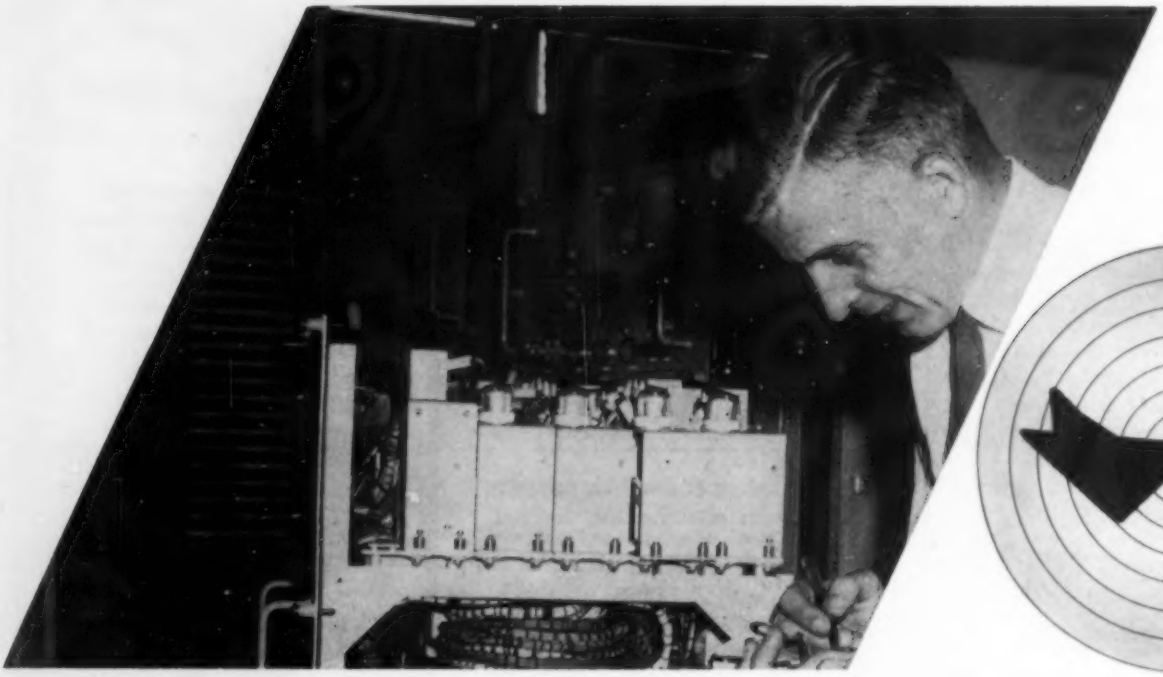
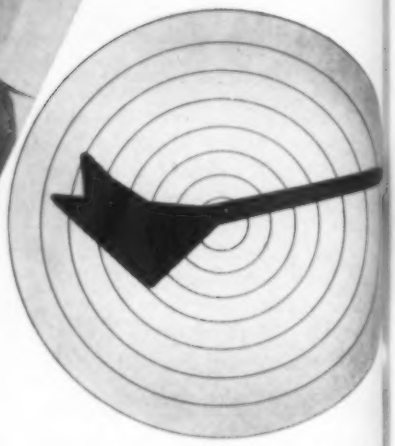
TEST EQUIPMENT ENGINEER John W. L... tells why his work in the B-70 weap... system at IBM Owego affords him the ... ative engineering career he always wan...

what's it like to be a creative engineer at IBM?





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Qualifications: B.S. or Advanced Degree in E.E. or Engineering Physics and 2 to 5 years' experience with magnetic circuitry. Must be familiar with fundamentals of non-linear magnetics and have strong interest in logical circuit application of magnetics.

PACKAGING ENGINEER to undertake development and design of packaging techniques and mechanical design of electronic equipment; to investigate temperature effects on packaging; to offer design support to computer, radar, and inertial development groups; to analyze present and proposed packaging design and recommend improvements.
Qualifications: B.S. in E.E. or M.E. and experience or advanced knowledge in latest electronic packaging techniques.

RADAR ENGINEER to analyze ultimate limits of present techniques and develop new concepts of providing topographical sensors for advanced airborne and space systems; to design airborne radar pulse, microwave and deflection circuitry; to analyze doppler radar systems in order to determine theoretical accuracy and performance limitations.
Qualifications: B.S. or Advanced Degree in E.E. and 3 to 5 years' experience in radar systems development, including display equipment and circuits, control consoles, and doppler or search radar design.

CIRCUIT ENGINEER to undertake advanced circuit design based on transistor-diode logic for digital systems; to review new circuits for application in digital control systems; to define t... techniques for improving performance chara... istics; to participate in advanced analytical s... ies associated with application of transi... circuitry to pulse and digital systems.
Qualifications: B.S. or Advanced Degree in ... and 2 years' experience with pulse circu... transistor circuit design or digital techniques.

GROUND SUPPORT EQUIPMENT ENGINEER assist in planning complete ground supp... equipment, including flight line, shop and d... equipment, for an advanced airborne weap... system. Must be experienced in developmen... test equipment for automatic checkout of c... plex weapons systems, including comput... radar, and inertial equipment.
Qualifications: B.S. or Advanced Degree in ... or related fields and 3 years' experience in de... oping ground support equipment.

A wide variety of exciting career opportunities awaits creative engineers and scientists at IBM Owego in applying IBM's computer technology to integrated B-70 bombing-navigation systems. Test Equipment Engineer John W. Lloyd, describing his assignments at IBM Owego, says: "Test equipment engineering is particularly stimulating when it's part of a project as new and important as the B-70, sometimes described as a 'huge flying computer.' Right now I'm coordinating the design of engineering support equipment for an advanced digital airborne computer, part of the B-70's bombing-navigation and missile guidance system. There's a minimum of routine. In order to design test equipment you must know—or learn—about the equipment to be tested; among these are radar, servo systems, digital and analog computers, and inertial guidance. I see my professional growth assured as IBM continues to develop computers for airborne applications."

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Science Information Meeting Explores Automation

WASHINGTON, D.C.—The problem of the storage and retrieval of scientific information was explored by specialists from more than a dozen countries at an International Conference on Scientific Information, held in Washington, D.C., November 16-31, under the sponsorship of the National Academy of Sciences—National Research Council, National Science Foundation, and American Documentation Institute.

Without convenient and rapid access to data from previous research, scientific progress is impeded. Under ideal circumstances, all such data is first published in full for workers in the immediate field; then abstracted for dissemination; indexed, codified, microfilmed or otherwise processed for storage; and, finally, retrieved in library search.

During recent years, however, the outpouring of data has all but overwhelmed the thin brigade of abstracters, indexers and other information specialists trained for the task. Quite simply, more scientific information is being produced that can effectively be stored and retrieved, and that body of information is said to be doubling every ten years.

Since the nature and scope of the problem was first examined formally by the Royal Society of London in 1948 and Unesco in 1949, various solutions have been offered—including many ingenious proposals for the use of mechanical and electronic aids in the preparation of material for storage and retrieval. Some of these methods have already been put to use and were described at the conference; others, such as mechanical devices for translating and abstracting, are still in the design or conjectural stages.

Although there is some controversy over the most promising solutions to the problem of storage and retrieval, there is little disagreement about its magnitude. At the present time, many investigators find it less expensive to conduct laboratory experiments anew than to search for previously reported data.

The conference program—which had been three years in preparation—included discussions of the kind of information scientists need, the effectiveness of present-day systems for organizing information, intellectual and mechanical problems encountered in the development of new systems, the search for a general theory, and finally a consideration of the responsibilities of government, professional societies, universities and industry.

R-652 actuates the tailwheel power steering installation in De Havilland of Canada's famous DHC-3 Otter.

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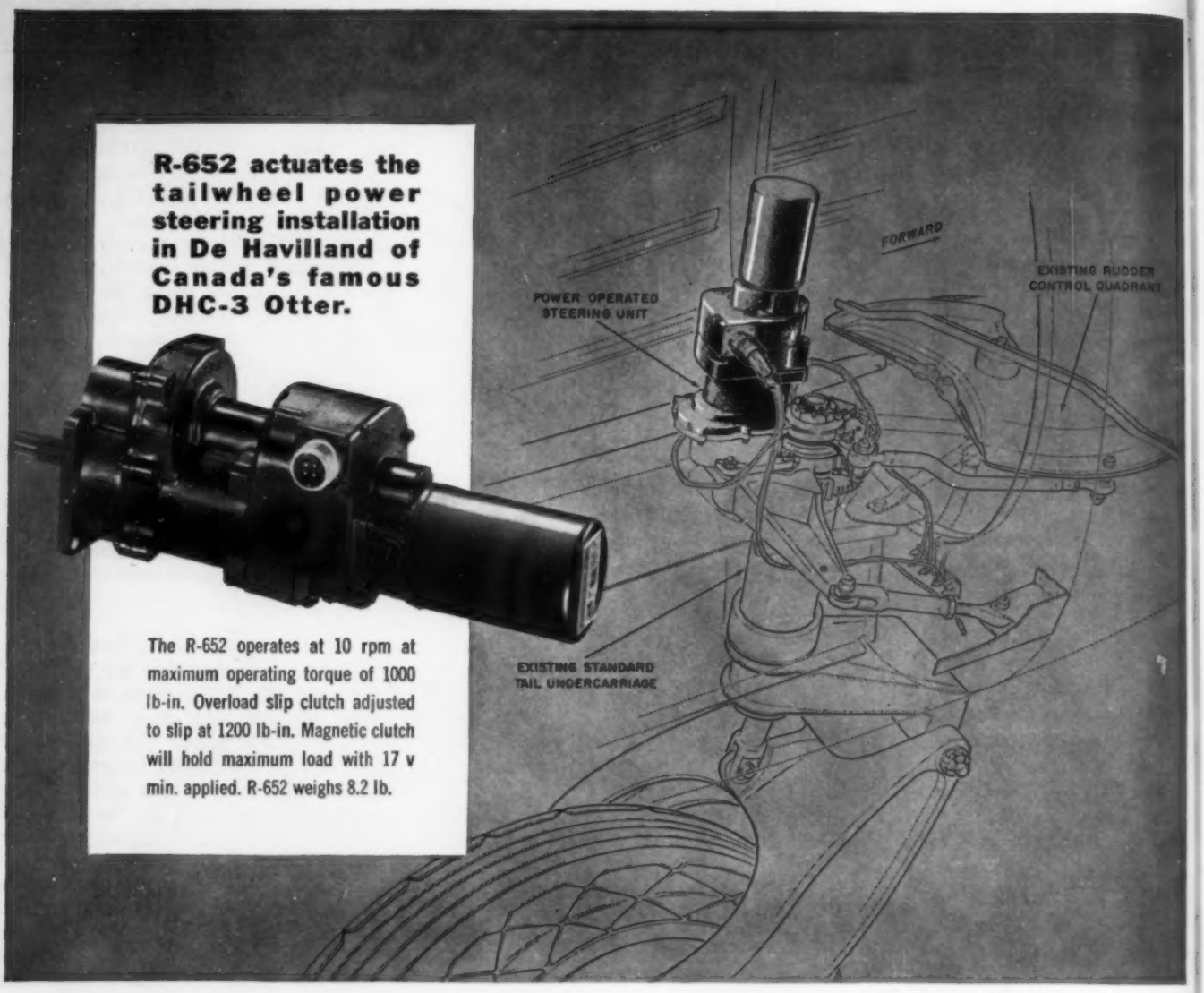

Drawing courtesy De Havilland Aircraft of Canada, Ltd.

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astrionics

by Raymond M. Nolan

Competition is getting hotter in the *Dart* replacement battle. Latest word is that Vickers is flying 25 of their *891* missiles and several technicians over so that evaluation can start. If the *891* is chosen, the only change from the present bird will be in electronics. Circuitry will be redesigned to use American transistors to ease maintenance problems.

Army Ordnance still says that the *SS10* or *SS11* will be the replacement, but people close to the situation claim that these missiles would wind up the same way as the *Dart* because "the *Dart* specification is impossible to meet." Vickers does not claim that the *891* can fill the spec—but it will do the job wanted—a lightweight hand-carried anti-tank missile, easy to set up and simple to operate for its one-man infantry crew.

There is still another contender though—the German-developed *Kobra*. Even though Pentagon officials say that the *Kobra* is "a dead item," don't discount this entry. The control system which reportedly made the U.S. shy away may be due for a change. Reports are that the Germans are now dickering with Vickers for the rights to the *891* control system for installation on the *Kobra*.

At any rate, it should be an interesting battle. But while it rages on, no development work or planning for this important weapon is in progress. It seems as though an early decision should be made if the new battle mobility concept of the Army is to proceed along planned lines.

Dr. Nicolaas Bioembergen, professor of physics at Harvard's Cruft Lab brought down the house at the recent NSIA ARDC-sponsored Molecular Electronics Symposium when he showed a slide of the radio telescope at the Naval Research Laboratory and said, "anyone who can afford a dish like this, can't afford not to use a MASER with it."

Dr. Bloembergen also described a new traveling wave MASER developed by Bell Labs. Performance is: forward gain, 23 db; backward attenuation, 29 db; tunable range, 5.8 to 6.1 kmc; bandwidth, 23 mc; and a noise temperature of 8 degrees K. The MASER uses a low-chrome pink ruby forward and a high-chrome red ruby backward with garnet slated to replace the red ruby. Pumping is 100 mw at K-band with 0.1 mw into the paramagnetic materials.

Another development reported was a ruby MASER working at 77 degrees K at the Royal Radar Station in Great Malvern, England. The noise isn't too good, but is an improvement over existing systems.

However, Dean Harvey Brooks of Harvard's School of Engineering stated in a talk on the same program that he did not see much possibility in solid state MASERs at room temperature.

At any rate, you can expect to see more and more interest in molecular electronics as various NASA and DOD space programs shape up. It is generally conceded that it is far easier to use MASER's in the receiving apparatus than to attempt building transmitters into the space craft large enough to overcome galactic noise. Size and operating temperatures are a problem but can be overcome fairly easily in ground installations.

And another remark made at the recent Electron Devices Meeting in Washington stands out, "We must examine all ideas very carefully, for the idea which seems worthless today may be of absolutely no value a month from now."

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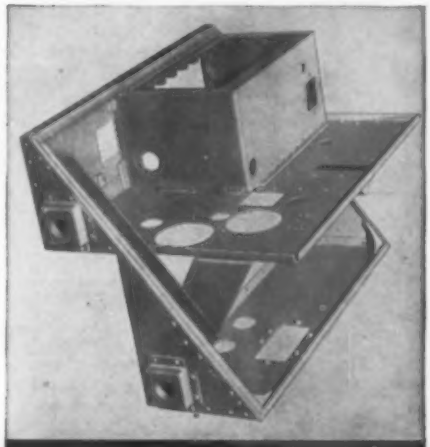
TITANIUM?
STAINLESS?
ALUMINUM?



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RAMJET SPECIALIST for preliminary design, evaluation and selection of ramjet engines and components for advanced missile programs. MS degree or equivalent plus 10 years progressive and intensive experience in all phases of ramjet engine research, design and development desired.

TURBOJET SPECIALIST to assume responsibility for preliminary design, evaluation and selection of turbojet engines and components for advanced missile programs. MS degree or equivalent plus 10 years progressive and intensive experience in all phases of turbojet engine research design and development desired.

THERMOCHEMICAL SPECIALIST to deal with transport properties of gases at high temperatures, dissociation and recombination phenomena and rates, high temperature gas and surface interaction and boundary layer flows involving sublimation or combustion. Ph D plus 5-7 years directly related experience desired.

SOLID PROPELLANT ROCKET ENGINE SPECIALIST to engage in preliminary design, evaluation and selection of solid propellant rocket engines for advanced missile programs. MS degree or equivalent plus 10 years progressive and intensive experience in solid propellants, grain configuration, combustion and hardware desired.

Salaries are commensurate with your background. Living and working conditions are excellent and employee benefits outstanding.

Write:

SUPERVISOR, ENGINEERING EMPLOYMENT, DEPT. U-62

BELL AIRCRAFT CORPORATION

BUFFALO 5, NEW YORK

space age

by Norman L. Baker

Decontamination for public pacification—Leading space medicine scientists believe sterilization of lunar payloads is a waste of time and current probes are only being made germ-free to "satisfy the public." Dr. Hubertus Strughold, Research Advisor for the AF School of Aviation Medicine, says there is only the smallest chance that earth microbes could survive on the moon even in the slight traces of atmosphere that might be trapped in the lunar craters. An ABMA scientist, agreeing with Dr. Strughold, says that the rocket's skin would be completely sterilized by the ultraviolet rays from the sun en route.

Venus or Mars will provide germ breeding ground—On the other hand, payloads sent to the atmosphere-enveloped planets of Venus and Mars will require maximum sterilization if we wish to protect any living organism that may exist there. For instance, pneumonia and tuberculosis germs, micro-organisms that subsist on carbon dioxide, would multiply at a tremendous rate on Venus with its heavily loaded CO_2 atmosphere. The entire organism population of the planet could be wiped out in a short time if the organisms failed to produce antibodies fast enough or strong enough to counteract the transplanted earth germs.

Moon a dead planetary body?—The recent report that a volcanic eruption had occurred on the moon, by "highly able and professional" Russian scientists, has brought conflicting reactions from leading astronomers. British astronomers branded the report "nonsense" and are viewing it with skepticism until two or more similar reports are made by astronomers of other nations.

Russian discovery collaborated—Dr. Dinsmore Alter, former director of Griffith Observatory, has collaborated the Russian discovery by reporting the presence of what he termed seeping gases on the floor of Alphonsus crater, the one in which the volcanic eruptions was reportedly photographed by the Russians. Alter added that an extensive series of photographs he had taken revealed an obscuration on the western side of the crater's 70-mile wide floor. Previously, most scientists have believed that all moon craters were formed by meteorite impacts.

Project Rotor—*Sputnik* III and its last stage launching rocket, regarded as the most valuable and spectacular satellites put into orbit, are destined to yield more invaluable data before their demise. The final stage rocket, calculated to end its orbiting life about December 4, is the object of a new study by the Research Station for Satellite Observation at the Harvard College Observatory. The study will calculate motions of the satellite about its own center of gravity. Now tumbling about its CG every 18.5 seconds, it causes two reflections of light, each about nine seconds long. By measuring the increase in the time interval between the light flashes as the satellite drops nearer the earth, precise measurements of the atmosphere's density can be made. Project Rotor is investigating the angle between the orbit at a particular moment, plus the tumble axis and the angle through which the tumble axis precesses.

Vandenberg Readies for First Missile Firings

by Robert Mount
Special m/r correspondent

VANDENBERG AFB, CALIF.—The Air Force is virtually ready to begin its countdown for the first ballistic missile launching from the West Coast.

Eight launching stations in the *Thor* IRBM complex at isolated Vandenberg AFB in North Santa Barbara County are more than 99% complete.

Ballistic Missile Division and Douglas Aircraft Co. are reportedly moving quickly in preparation for the first four launchings from the Strategic Air Command's first operational ballistic missile site.

The first launch is expected in a matter of days and the first West Coast satellite launching, utilizing a *Thor* vehicle is anticipated on November 30 or December 1. This may be a test version of WS-117L, although a December 19 date is rumored.

In addition, the three pads in the initial *Atlas* complex are 94% complete, indicating an operational capability will be achieved for ICBM launchings in the very near future.

• **Titan pad progressing**—Completion of a second *Atlas* complex is expected by mid-spring. The *Atlas* and *Thor* complexes represent initial contracts of over $18.5-million. Completion date of the first *Titan* pad, now well along in construction, is indefinite.

Before January the Air Force expects to have let $62-million of the estimated $100-million cost of initial construction.

The *Thor* guidance facilities have already been completed and the $1.6-million oxygen plant is 97% complete.

Underground communications facilities for the *Atlas-Thor* complexes are 96% complete. The guided missile maintenance and assembly facilities costing $1.7-million are 99% complete, along with roads to the *Thor* complex. The *Thor* pads can be considered ready to do business.

Basic construction was completed by the U.S. Corps of Engineers last month when their facilities were turned over to the Air Force for technical completion and final check out.

As soon as the first *Thor* launching is complete the Air Force can look forward to the beginning of intensified training of missile men by the First Missile Division at Vandenberg.

• **RAF in training**—Some 160 Royal Air Force personnel and about 50 USAF missile men are already in training, although their work is presently heavily weighted with blackboard rather than practical field instructions.

Small parts requiring very close tolerances and numerous machine operations have been our specialty during the past half-century! We invite your quotation requests and suggest that you write for our illustrated brochure to see how our facilities can be put to work for you!

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—compact, reliable units for telemetering readout and control

These Photocon counters add and/or subtract electrical pulses at speeds up to 20 counts per second. Each digit on each wheel has a contact, for remote indication or control. Counters available with precision resistors mounted between contacts. Counter provides an analog or digital output.

High accuracy—there is no gain or loss of counts over a life of 10,000,000 counts. A balanced armature insures accurate counting during severe vibration.

High reliability—contacts are made from precious metals to eliminate contact noise. Wearing parts are built of Nylon for long life.

Small size—only 1 13/16" high x 3½" wide x 3¼" deep. Weight is only 22 ounces. Available in 3-, 4-, and 5-digit counters...also in shaft-driven models. Units can be preset, and hand reset. Write for literature on Photocon Model MCP-1005.

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or a pressure actuated valve,
ontrolling flow of helium for
OX tank pressure regulation:

mbient Temperature
65°F to +120°F

emperature Shock
260°F for 5 seconds, then to
400°F in 25 seconds

ressure Shock
to 3000 psi in ½ second

ontrol Tolerance
6 psig. + zero, −1.3 psi,
small ullage

Response Time
Zero to rated flow in ½ second.

Design considerations:
Rate of flow of helium
s fixed by rate of evacuation
of LOX tank;
riction in all metering elements
must be minimal
at all temperatures;
chatter must be prevented
despite pressure shock;
response must be rapid
despite long signal
sensing lines.

Results: A valve
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meeting all of these requirements
is now operational—
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contribution to
America's missile program.

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move it in . . . couple it . . . turn it on . . .

with a VICKERS "packaged" unit power is instantly available to operate your missile-support system

Fast and easy installation is an important advantage of these "packaged" hydraulic power and control systems by Vickers. It saves time at the missile site — keeps "on-the-spot" labor charges low. That's important! Yet this fast installation is only one of the benefits you get with these factory-built power packages.

Save Design Time — Since 1932 Vickers has custom designed hydraulic power packages. Thus, we know how to avoid "false starts" and can develop highly efficient units *in a hurry*.

Eliminate Mismatching — Each power package contains compatible, balanced components all produced by Vickers. There are no hybrids — there is no need for "force fits".

Save Space — Units are surprisingly compact, yet all components are easily accessible. Solid steel drilled manifolds reduce piping and space. Components, lines and connections are kept to an absolute minimum.

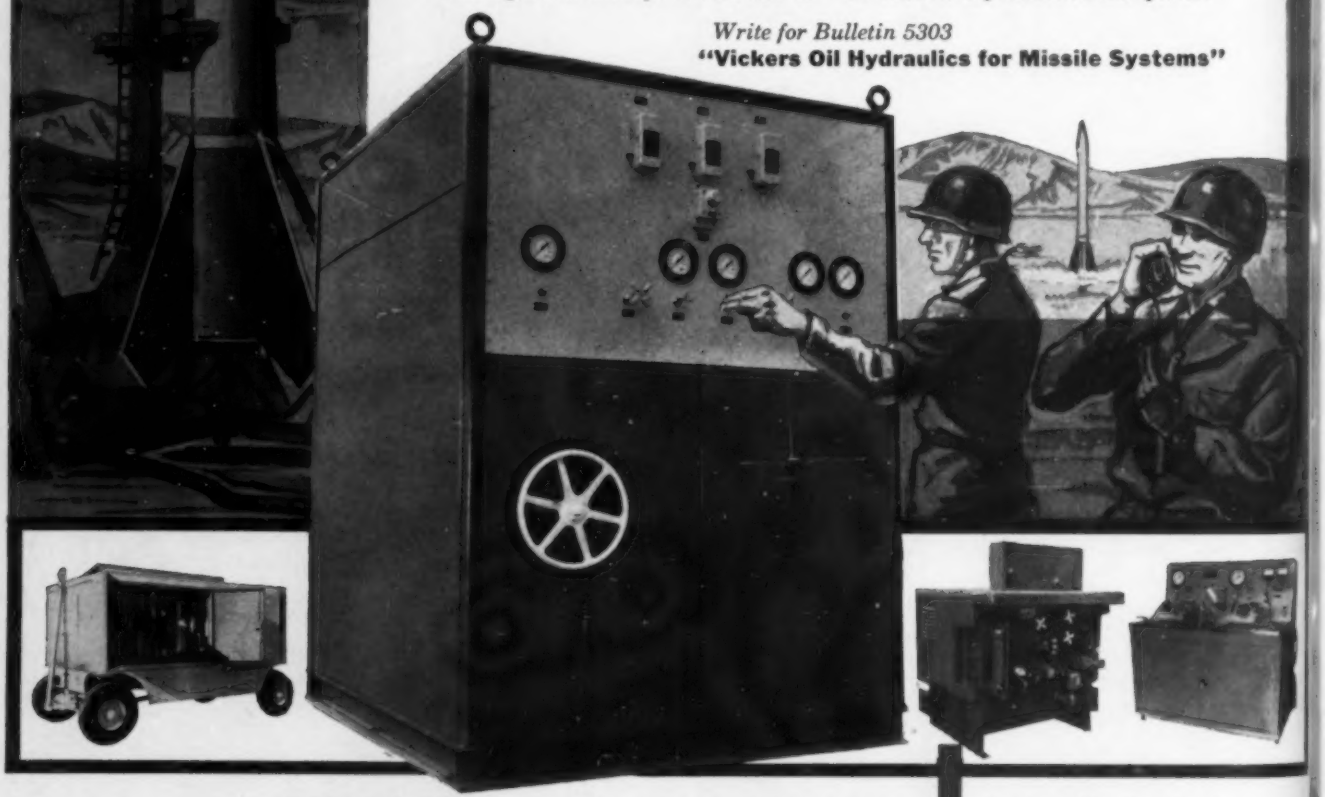
Simple Field Adjustment — The building-block concept is followed to give component interchangeability, servicing ease and quick location of any malfunction. All components are individually tested; complete power units are pretested before shipment.

Insure Predictability — Vickers designs and builds systems which meet the most rigid performance specifications including predicted ambient temperature, weather and other conditions.

Reduce Field Inventory — As far as possible, units are designed with components that are commercial "shelf" items. Inventories of warehouse stocks can be kept low because of component and part interchangeability.

How far advanced is your project? If it is in the design and development stage, we can *immediately* place a team of hydraulic specialists in your plant to work with your engineers. If it is in the "breadboard" stage, let us give you an alternate proposal. On many applications we have suggested much improved power units at attractive production-line prices.

Write for Bulletin 5303
"Vickers Oil Hydraulics for Missile Systems"



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Decision Expected Soon on U.K. Space Program

LONDON—A committee of the Royal Society, equivalent to the U.S. National Academy of Sciences, is advising the U.K. government on the feasibility of establishing a British spaceflight program, and to investigate projects which might be undertaken with satellites and probe rockets.

Speculation that an announcement was imminent concerning the government's decision on such a program was denied at the opening of a discussion meeting on space research held here, and indications were that a firm decision has not yet been made.

Immediately following the meeting, a charter, rules of procedure and plan of organization were drawn up for the International Committee on Space Research, subject to approval by the International Council of Scientific Unions. It was reported that the International Committee, at its first meeting, had reached agreement that any country would be allowed to carry out space experiments using American or Soviet satellites (m/r, Aug. 18, p. 33).

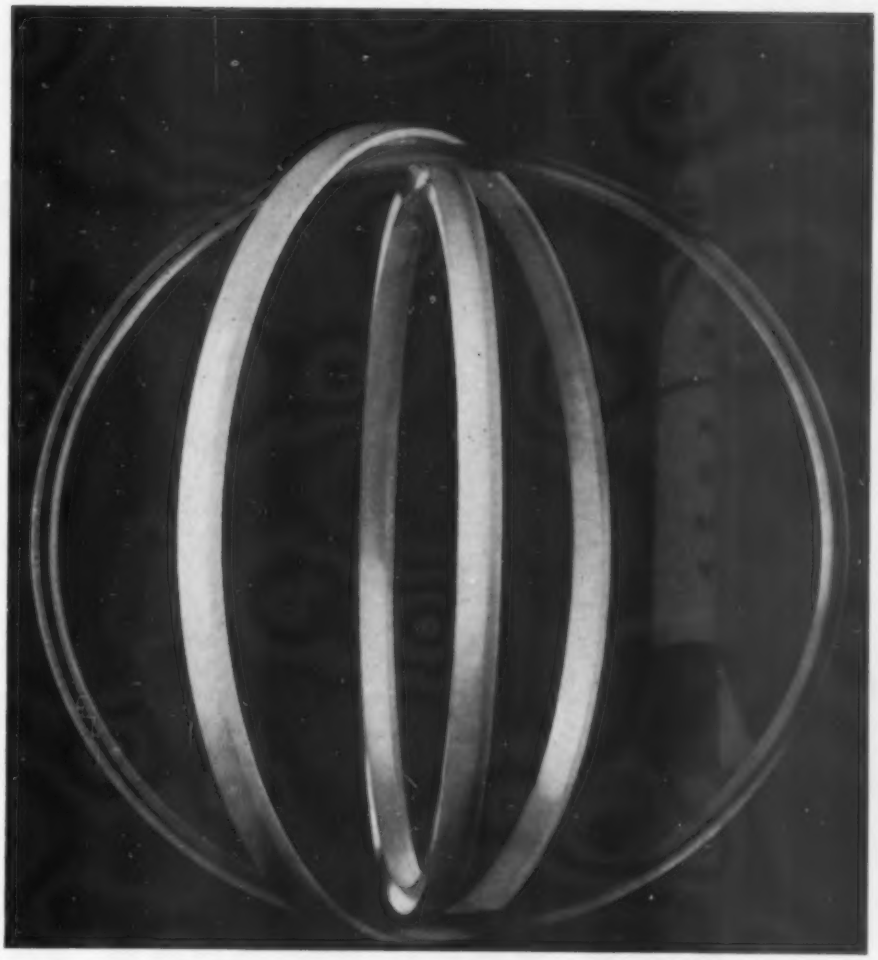
Applications by foreign scientists to put their equipment aboard satellites would be decided on merit by the committee, and the equipment placed aboard the particular satellite considered most suitable. The Soviet scientist reportedly insisted that details of their rockets and methods of launching remain secret.

During the meeting itself, Prof. S. Chapman, formerly of Oxford University, advanced the theory that the sun's corona extends beyond the earth and that its temperature in the region of the earth's orbit was around 220,000°C. This, according to Prof. Chapman, was the source of heat flowing downward into the upper atmosphere, and the earth was in effect a cold spot in a hot gas. The theory was supported by recent findings that temperature gradients in the upper atmosphere are several times steeper than believed.

New Missile Ship Ready on West Coast

PORT HUENEME, CALIF.—The multi-million dollar experimental and training missile ship King County has joined the growing fleet of special Navy vessels assigned to the Pacific missile range.

The King County is in Port Hueneme Harbor near Point Mugu. She is a converted LST carrying a mockup of the *Regulus II* and the conning tower, launcher, television cameras and a hangar for the Halibut and her sister submarine, Grayback.



new techniques match TEFLON to missile needs

Don't underestimate the possibilities of du Pont TEFLON as fabricated, today, by United States Gasket Company. Perennial pioneers and leaders in advanced techniques of manufacture and application of TEFLON T.F.E. fluorocarbon plastics—recent U.S.G. developments bring an entirely new conception of the scope of usefulness of this remarkable material in the missile field. One example—"Fusion welding" of TEFLON T.F.E. has broken through the limiting size barrier of fluorocarbon plastic structures. Another example—"filled" TEFLON is providing materials with particularly desired characteristics not possessed by the virgin material—new qualities "custom-tailored" to specific use requirements.

United States Gasket Company engineers invite the opportunity of applying the latest TEFLON techniques for the solution of your design problems.

For prompt service, contact one of The Garlock Packing Company's 30 sales offices and warehouses throughout the U.S. and Canada, or write

United States Gasket Company
Camden 1, New Jersey

United States Gasket

Plastics Division of GARLOCK

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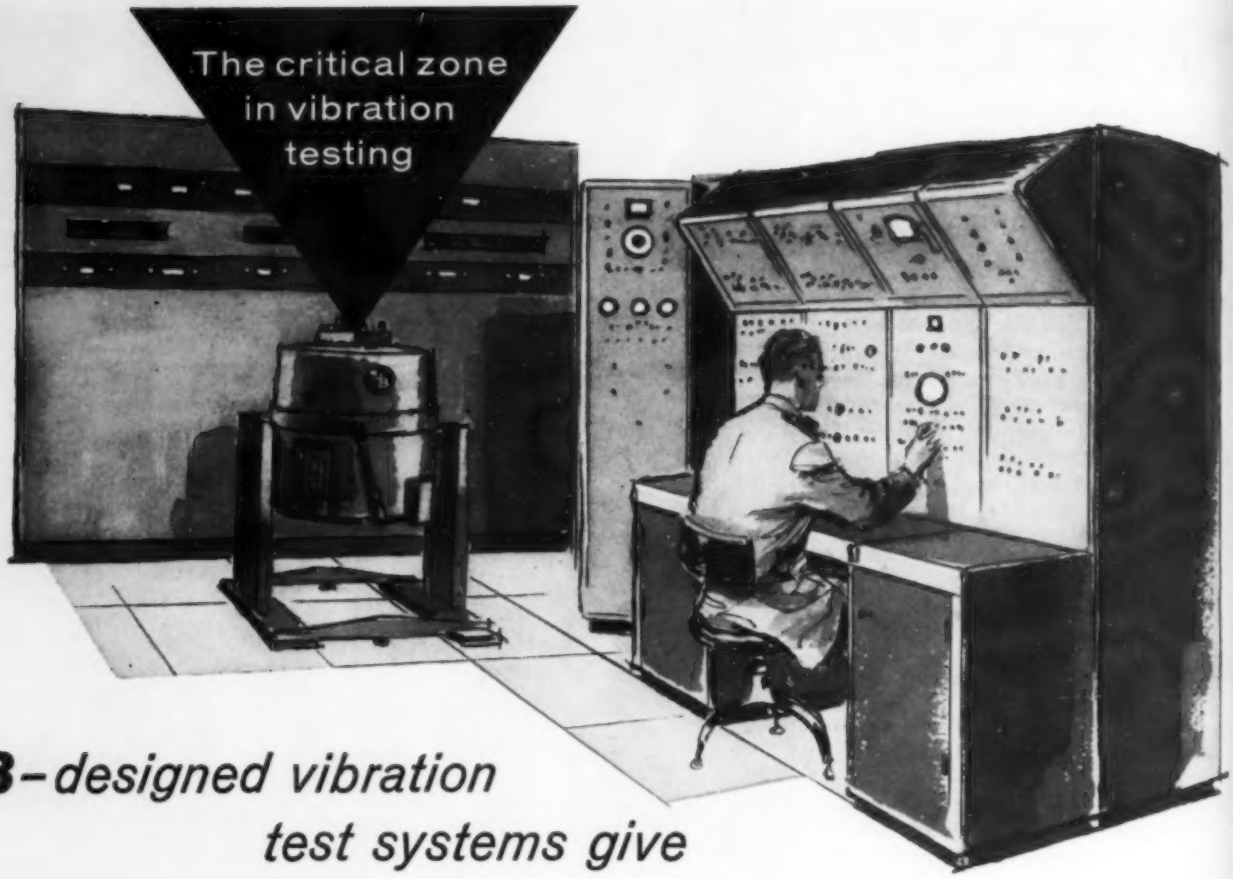

***MB**–designed vibration test systems give*

high performance table motion

It's *System Performance* that counts most in vibration testing.

Whole purpose of a vibration test system, large or little, is to subject specimens to *motions* that simulate service conditions as closely as possible. Such motion gives you *reliable* information on vibratory response and performance of structures, products, components. It helps reduce risk of malfunction or failures in the field.

But many factors contribute to this motion. Among them: force output and characteristics of the exciter; ample and undistorted power supply to meet all shaker-plus-specimen load relationships; meticulous matching of components in the entire system from input signal to output at the shaker table.

INTEGRATED SYSTEM OFFERS OPTIMUM RESULTS

As the manufacturer of *complete* systems, MB intimately knows the operational needs of shaker, builds amplifiers and controls around those needs. Each MB system is integrated toward the highly desired end result . . . *delivering optimum performance at the shaker table* for present and future needs.

The largest field service organization in vibration testing is ready to help you achieve that result. For latest information, call on MB.

HIGH FORCE HIGH PERFORMANCE SYSTEM

Shown above is a typical MB test system. It includes a Model C70 7000 pound force vibration exciter fit for environmental testing chambers.

The MB T996 amplifier is rated at 50KVA output and can handle the most adverse reactive shaker loads for broad-band sine wave and random motion testing. The T68MC control console is easy to use, also provides automatically cycled testing. The T88 console expands system for complex motion work.

Send for Bulletin 470 which gives detailed specifications on the high performance available from this system; and from others to 25,000 pounds force.

largest producer of complete systems for vibration testing

MB manufacturing company 1055 State Street New Haven 11, Conn.

A Division of Textron Inc.

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when and where

DECEMBER

American Society of Mechanical Engineers, Annual Meeting, Hotels Statler-Hilton and Sheraton-McAlpin, New York, N.Y., Dec. 1-5.

Third EIA Conference, Reliable Electrical Connections, Dallas, Texas, Dec. 2-4.

Institute of Radio Engineers and American Institute of Electrical Engineers, Second National Symposium on Global Communications, Colonial Inn, St. Petersburg, Fla., Dec. 3-5.

Eastern Joint Computer Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa., Dec. 3-5.

Institute of Radio Engineers, Ninth National Conference, Professional Group on Vehicular Communications, Hotel Sherman, Chicago, Ill., Dec. 4-5.

Plas-Tech Equipment Corp., Symposium on High Speed Testings, Sheraton-Plaza Hotel, Boston, Mass., Dec. 8.

Mid-American Electronics Convention, sponsored by Kansas City Section, Institute of Radio Engineers, Municipal Auditorium Arena, Kansas City, Mo., Dec. 9-11.

American Astronautical Society, Fifth Annual Meeting, Hotel Statler, Washington, D.C., Meeting will be held in conjunction with the 125th Annual Meeting of the American Assn. for the Advancement of Science, Dec. 27-30.

JANUARY

Reliability and Quality Control in Electronics, Fifth National Symposium, Bellevue-Stratford Hotel, Philadelphia, Pa., Jan. 12-14.

Fifth Annual Radar Symposium (classified), Rockham Bldg., University of Michigan, Ann Arbor, Mich., Jan. 27-29.

Society of Plastics Engineers, 15th Annual Technical Conference, Hotel Commodore, New York, N.Y., Jan. 27-30.

Armour Research Foundation, Fifth Annual Midwest Welding Conference, Illinois Institute of Technology, Chicago, Ill., Jan. 28-29.

FEBRUARY

Society of the Plastics Industry, 14th Annual Technical and Management Conference, Edgewater Beach Hotel, Chicago, Feb. 3-5.

1959 Solid State Circuits Conference, Institute of Radio Engineers' Professional Group on Circuit Theory, American Institute of Electrical Engineers' Committee on Electronics and the University of Pennsylvania, Philadelphia, Pa., Feb. 12-13.

project:

FUELING MISSILES — FASTER

FRI develops successful automated hookup and couplings for fast LOX and fuel transfer

Here, the problem was 5-fold. (1) Develop a flexible coupling for automated hookup. (2) Prevent leakage. (3) Protect vital internal parts from icing. (4) Provide high flow with minimum pressure drop. (5) Keep weight to a minimum.

Flight Refueling, Inc. solved it. The long experience of Flight Refueling, Inc. in developing, testing and manufacturing lightweight aerial systems, and the recent experience of designing components for the transfer of hydrocarbon fuels, LOX, H_2O_2, N_2, mercury and other nuclear reactor coolants, as well as heated gases, has resulted in the successful completion of many unusual projects.

If you are concerned with *fast fluid transfer,* remember this—FRI has the engineering imagination to design complete lightweight systems, and manufacturing facilities to produce in quantities such components as valves, couplings, nozzles, fittings and portable tanks. Write for literature.

Flight Refueling, Inc.

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West Coast Representative: William E. Davis, Box 642, Inglewood, Calif.

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Engineering problem:

Pressure-tight fastening of transit cases

The solution:

A specially modified LINK-LOCK

Applied Design Company engineers worked with Simmons to develop this successful LINK-LOCK application

Simmons LINK-LOCK, with design modifications developed in cooperation with the Engineering Department of Applied Design Company, Buffalo, New York, resolves special closure requirements in rigidly specified transit cases like the aluminum equipment container shown.

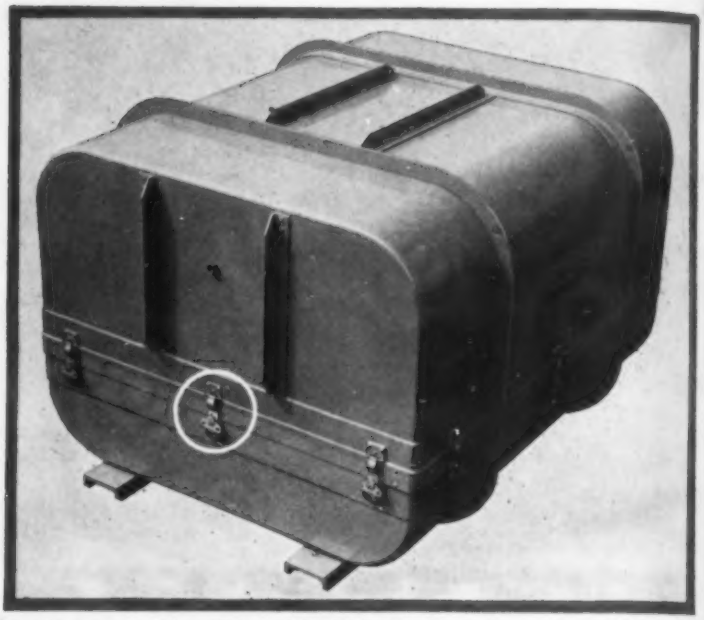
Here, the bowed LINK-LOCK engagement blade provides the double advantage of maintaining constant fastener pressure and permitting considerable mounting tolerance. This container is just one of many important products in which Applied Design specifies standard and special Simmons Fasteners.

Here's why LINK-LOCK is ideal for use on military cases produced to exacting specifications as well as on inexpensive commercial containers:

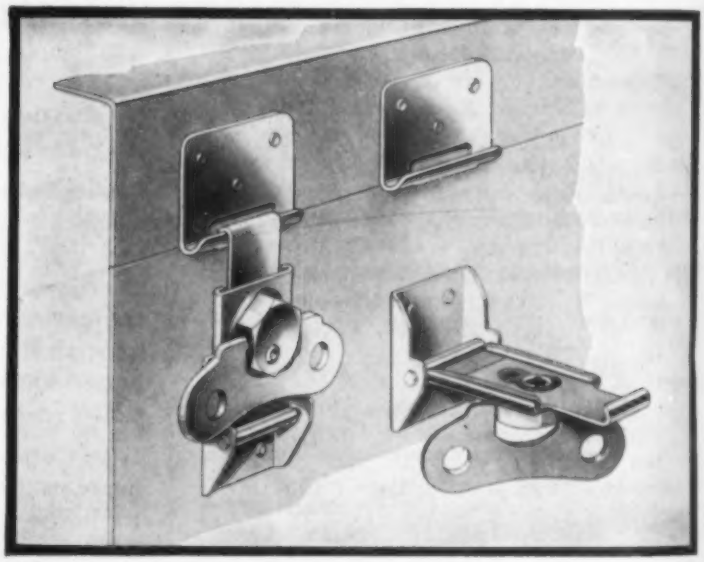
- Impact and shock resistant (positive-locking).
- High closing pressure with light operating torque...insures pressure-tight seals where required.
- Available in 3 sizes, for heavy, medium, and light duty.
- Compact design...lies flat against case even when unlocked.
- Opening and closing by wing-nut, screwhead, or hex nut.
- Flexible engagement latch design...can be varied to suit different conditions.

Also available: Spring-Loaded LINK-LOCK. Ideal for the less expensive containers where costs won't permit precision production. Spring provides take-up to compensate for set in gasketing, irregularities of sealing surfaces, and mounting inaccuracies.

SEND TODAY for the Simmons Catalog for complete information and engineering data on LINK-LOCK and other Simmons Industrial Fasteners. Engineering service is available; outline your particular fastening problems. Samples on request.



Twelve special loop-blade LINK-LOCK fasteners are used in this aluminum transit case designed by Applied Design Company.



Standard No. 2 LINK-LOCK (Medium-Duty). Available with screwhead, wing-nut as shown, or hex nut.

SIMMONS

FASTENER CORPORATION

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QUICK-LOCK · SPRING-LOCK · ROTO-LOCK · LINK-LOCK · DUAL-LOCK · HINGE-LOCK

See our 8 page catalog in Sweet's Product Design File

contract awards

ARMY

By the Department of the Army:

$1,570,000—**C. H. Leavell and Company** of El Paso, Texas for construction of *Nike-Zeus* developmental facilities at the White Sands Missile Range in New Mexico.

By U.S. Army Ordnance District, Los Angeles, Pasadena, Calif.:

$140,000—**North American Aviation, Inc.,** Canoga, Park, Calif. for design and development and $194,000 for rocket engines.

By Purchasing and Contracting Division, White Sands Missile Range, N.M.:

$58,288—**Nems Clarke Co.,** Division Vitro Corp. of America, Silver Spring, Md. for crystal controlled telemetry receivers and components.

$25,800—**Sperry Gyroscope Co.** Division, Sperry Rand Division, Great Neck, N.Y. for klystron tubes.

By the Office of the District Engineer, U.S. Army Engineer District, Baltimore, Corps of Engineers, Baltimore 3, Md.:

$129,500—**Keane Construction Co., Inc.,** Fort Lee, N.J. for special conversion for *Nike-Hercules,* Sites BA-18D-CL, BA-30D-C1 and BA-79D-C1, Maryland, consisting of new 8,000 gal. underground oil storage tank; elevator pump unit; government-furnished structural modifications to elevators, including locking bar supports, bolster, launching pad support, deck support beams, portland cement concrete pavement; security fencing and lighting.

By U.S. Army Ordnance Missile Command, Redstone Arsenal, Redstone Arsenal, Ala.:

$29,892—**Scintilla Division,** Bendix Aviation Corp., Sidney, N.Y. for electrical connectors.

$25,982—**Rome Cable Corp.,** Rome, N.Y. for guided missile test facilities.

$33,146—**Wiancko Engineering Co.,** Pasadena, Calif. for pressure pickups with varying ranges.

By U.S. Army Signal Supply Agency, Philadelphia, Pa.

$99,175—**Cornell University,** Ithaca, N.Y. for research work for 12 months to conduct a program of investigation and analysis of electron tube field failures.

$81,728—**Varian Associates,** Palo Alto, Calif. for research work for nine months covering a study of molecular and atomic resonance devices.

$59,822—**United Research, Inc.,** Cambridge, Mass. for research and development work for 4½ months on wind shear measurements.

$950,000—**Rheem Manufacturing Co.,** Aircraft Div., Downey, Calif. for redirection of work to be performed under the contract in the manufacture of 15 surveillance drones.

$95,413—**Hi-Q Division Aerovox Corp.,** Olean, N.Y. for research and development work for 18 months on transistor temperature compensation capacitors.

$75,382—**Radio Corp. of America,** Harrison, N.J. for research study of electron tube materials, gases, and getters, for 12 months.

$96,549—**Western Electric Co., Inc.,** New York, N.Y. for 12 months study to continue investigation of lutra-precise quartz crystal controlled oscillators, quartz crystal resonator.

By U.S. Army Ordnance District, Philadelphia, Philadelphia, Pa.:

$185,240—**Western Electric Co., Inc.,** New York, N.Y. four contracts for *Nike* spare parts and components.

$17,961—**The Trustees of the University of Pennsylvania,** Philadelphia, Pa., for determination of local magnetic fields and nuclear magnetic moments.

NAVY

By Supply Officer, U.S. Naval Gun Factory, Washington, D.C.:

$77,628—**Vickers, Inc.,** Waterbury, Conn. for repair parts, missile feeder MK 9-0, Handling BW-1 missile, hydraulic and electrical equipment for parts list R-23976-1.

$90,455—**Vickers Inc.** Electric Products Div., Saint Louis, Mo. for amplifiers, reactors, transformers, etc., to be used as spare parts for missile-launching system.

$74,110—**Associated Steel Co.,** Houston, Texas for stainless steel tubing various sizes for missile launcher MK 11-0 PML 12, 81,621 ft.

Bristol miniature pressure switch

features ultra-reliable precision pressure element. Exclusive design provides outstanding resistance to shock, vibration, acceleration and overpressures.

These Bristol miniatures, widely proved in modern aircraft, are designed for switching electrical circuits in response to pressure changes in air, fuels, lubricants, hydraulic fluids, other gases and liquids.

Bristol's specially designed Ni-Span element is silver brazed to the stainless steel base assuring greater reliability than ordinary soft-soldered construction. Result: accurate, reliable, repeatable performance in any position, at temperatures from −65° F to +250° F, and under Mil Spec environmental requirements.

Write for Bulletin AV2010 on Bristol Miniature Gage and Absolute, Adjustable and Differential Switches. The Bristol Company, Aircraft Components Division, 173 Bristol Road, Waterbury 20, Conn. 8.44

SPECIFICATIONS (Fixed pressure setting models)

Normal Working Range – 0 to 100 psi absolute, gage, or differential

Burst Pressure – exceeds 250% of normal working pressure

Electrical Ratings – 5 amp at 125 v, 60 cycle, inductive or resistive
4 amp at 30 vdc resistive
2.5 amp at 30 vdc inductive

Dielectric Strength – 500 v rms between terminals and from terminals to case (MIL-S-8801)

Life at Rated Electrical Load – 40,000 cycles at 125 vac
25,000 cycles at 28 vdc

High Temperature Exposure & Operating – (MIL-S-8801) 250° F

Low Temperature Exposure & Operating – (MIL-S-8801) −65° F

Shock, 30 g, 3 axes – (MIL-S-8801) no change

Vibration – (MIL-S-8801) no contact chatter, no switch damage
300-600 cpm at 0.050" d.a.–set point change–none
operating differential change–none
600-4500 cpm at 0.036" d.a.–set point change–¼ psi
operating differential change–½ psi
4500-30,000 cpm at 10 g–set point change–¼ psi
operating differential change–½ psi

Diameter–1-5/16

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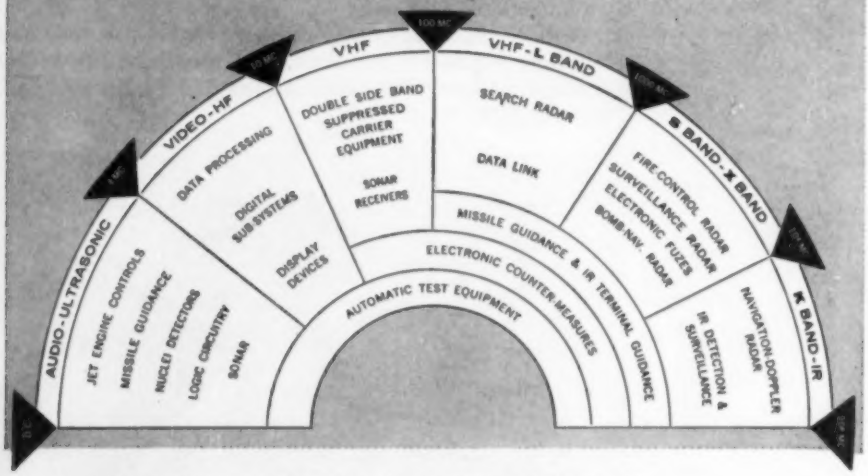

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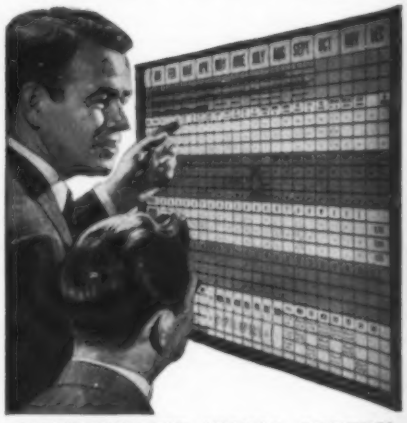

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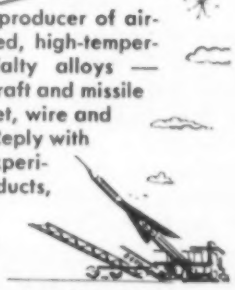

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